THE REGIONAL METROPOLITAN TRANSIT AUTHORITY OF OMAHA

d/b/a/ METRO

INVITATION FOR BID

(IFB)

BOILERS REPLACEMENT

PROJECT #: NE-90-X144

SPEC #: 04-26

03-16-2026

Bids must be submitted by: April 8, 2026, by 2:00 p.m. CST

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BOILERS REPLACEMENT
PROJECT #: NE-90-X144, SPEC #: 04-26

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NOTICE OF INVITATION FOR BID (IFB)
Boilers Replacement Project at 2222 Cuming Street, Omaha, NE
PROJECT No.: NE-90-X144
("Project")

The Regional Metropolitan Transit Authority of Omaha d/b/a Metro **("Metro Transit")** is requesting bid from qualified responsible contractors for the performance of Work (as defined in the IFB Documents) in conformity with the Contract Documents (as defined in the IFB Documents). Metro Transit will receive sealed bids for that purpose, until **Wednesday April 8, 2026, 2:00 pm Central Daylight Time**, (**"Submission Deadline"**) at which time Metro Transit will publicly open and read the tabulated bids. Bids not received by Metro Transit as of the Submission Deadline will not be considered responsive and will not be opened. Bids not meeting specified delivery and methods of submittal will not be considered responsive and will not be opened. Metro Transit reserves the right to extend the Submission Deadline by issuing an Addendum.

Prospective Bidders should refer to the Bid Documents for a detailed description of the Base Bid including the required deliverables and end products. For informational purposes only, the Work includes, but is not limited to, the following:

The proposed project encompasses removal and replacement of the current dual-fuel boilers, system pumps, associated mechanical and plumbing equipment, fan coil units, and heating units. Outlined below is additional detail of the work to be accomplished:

- Removal of the existing two (2) dual-fuel boilers, three (3) pumps, and associated branch piping and ductwork as shown in Plan Set.
- Remove Level 1 and Lower-Level piping as shown in the Demolition Plans.
- Remove existing Level 1 and Lower-Level floor and wall mounted heaters and associated branch piping, tees and valves as shown in the Demolition Plan.
- Remove and replace existing air intake ductwork and equipment as identified in the Plan Set.
- Provide and install two (2) condensing boilers and associated mechanical and plumbing equipment.
- Provide and install one (1) dual-fuel boiler and associated mechanical and plumbing equipment.
- Provide and install three (3) heating water pumps and associated equipment.
- Provide and install thirty (30) unit heaters and connect new piping, new insulation, and valves on branch lines on Level 1 and Lower Level of the building.
- Provide and install thirty (30) wall mounted baseboard/fin tube/convector heaters and connect new piping, new insultation and valves on branch lines on Level 1 and Lower level of the building.
- Provide and install thermostats to control heater units, including connections to building management system.

The current forms of the IFB and all issued Addenda are available for inspection at Metro Transit's Administrative Offices located at 2222 Cuming Street in Omaha, Nebraska ("Administrative Offices") and online at the following links www.standardshare.com will be on Standardshare 3-16 and www.ometro.com. Metro Transit reserves the right to modify all or any of the same at any time prior to the Submission Deadline through an Addendum.

Without limitation to any right of Metro Transit set forth in the Bid Documents, it is anticipated that Metro will award a firm fixed price (lump sum of aggregate of unit prices) Contract to the responsible bidder whose bid complies with bid requirements and is lowest in price. It is anticipated that the Contract will be awarded no later than (30) days after the date of the Bid Opening.

A Non-Mandatory Pre-Bid Conference will be held on Tuesday, March 24, 2026, at 2:00 pm Central Day Light Time in Metro Transit's Administrative Office Board Room located at 2222 Cuming Street, Omaha NE 68102. This Pre-Bid Conference is not mandatory, but contractors are encouraged to attend.

Virtual Meeting:

Zoom Meeting
https://us06web.zoom.us/j/84803101517

Meeting ID: 848 0310 1517

All bids must be made on the forms (and contain all certificates, documentation, and information) required by the IFB Documents and must be accompanied by Bid security in the amount and on forms required thereby. Any bid that does not fully comply with any requirement of the IFB Documents will be considered non-responsive, and Metro Transit shall be entitled to reject any such bid at any time. Metro Transit reserves the right to waive any minor informality or mere irregularity contained in any bid.

No bid will be construed to be binding on Metro Transit unless: (i) A Contract first has been awarded by its Board of Directors at a public meeting; (ii) The Contract has been duly executed by each of the Contractor and Metro Transit, and (iii) All conditions applicable to such award of the Contract and as otherwise may be set forth in the Contract Documents have been fully satisfied.

Bids must be received with all required submittals as stated in the IFB, no later than **April 8, 2026, at 2:00 pm Central Daylight Time**, at which time they will be publicly opened, read and tabulated by Metro Transit at Metro Transit's Administrative Offices Board Room located at 2222 Cuming Street, Omaha, NE 68102. Metro Transit prefers Bids to be submitted via Mail or hand delivery. The upper-left hand corner of the sealed enveloped must identify the following information:

(Name of Contractor/Bidder)
Sealed Bid for project:
BOILERS REPLACEMENT
NE-90-X144, Spec. No. 04-26

Envelopes, containing bids must be sealed and addressed to:

The Regional Metropolitan Transit Authority of Omaha Metro
Attn: Procurement and Contracts Manager
04-26 BOILERS REPLACEMENT
2222 Cuming St
Omaha NE 68102-4392

Due Date, regardless of submission type is: 2:00 pm, Central Daylight Time, April 8, 2026. For information regarding this bid contact the Procurement and Contracts Manager at procurement@ometro.com or call: 402-341-7560 Ext. 2272. Any questions of request for clarification are due from Bidders on March 26, 2026, at 2:00 pm Central Daylight Time and submitted on the appropriate

form included in the IFB. *See Exhibit: Request for Clarification or Substitution*. Metro Transit's response to these submissions will be in the form of an Addendum.

No person or entity submitting a bid in response to this IFB, nor any officer, employee, agent, representative, relative or consultant representing such a person (or entity) may contact through any means, or engage in any discussion concerning the award of this contract with any member of Metro Transit's Board or any employee of Metro Transit (excluding Procurement staff) during the period beginning on the date of bid issue and ending on the date of the selection of Contractor. Any such contact would be grounds for disqualification of the Bidder.

SECTION 1 – PROJECTED BID SCHEDULE

Bid Advertised and Issued	March 16, 2026
Non-Mandatory Pre-Bid Conference Metro's Administration Office Building, Board Room 2222 Cumming Street, Omaha NE 68102 Virtual Meeting: Zoom Meeting https://us06web.zoom.us/j/84803101517 Meeting ID: 848 0310 1517	March 24, 2026, at 2:00 pm CST
Questions/Requests for Clarifications of Substitution	March 26, 2026, at 2:00 pm CST
Metro's Response to Questions/Requests for Clarification of Substitution	March 30, 2026, at 4:00 pm CST
Bid Closing	April 8, 2026, at 2:00 pm CST
Public Bid Opening Metro's Administration Office Building, Board Room 2222 Cumming Street, Omaha NE 68102	April 8, 2026, at 2:00 pm CST
Board Award	April 30, 2026

SECTION 2. SCOPE OF SERVICES

2.1 SCOPE

Technical Specifications and Drawings for the project are attached to this IFB. The intent of the Plans and Specifications are to describe the Work which the Contractor undertakes to do, in full compliance with the Contract, and it is understood that the Contractor will furnish, unless otherwise provided in the Contract, all materials, machinery, equipment, tools, supplies, transportation, labor, and all other incidentals necessary to the satisfactory completion of the Work. The Plans and Specifications are complementary, and what is called for by either is as binding as if called for by both.

Described below are the project elements to be accomplished through the Work.

Base Bid Projects Elements:

The proposed project encompasses removal and replacement of the current dual-fuel boilers, system pumps, associated mechanical and plumbing equipment, fan coil units, and heating units. Outlined below is additional detail of the work to be accomplished:

- Removal of the existing two (2) dual-fuel boilers, three (3) pumps, and associated branch piping and ductwork as shown in Plan Set.
- Remove Level 1 and Lower-Level piping as shown in the Demolition Plans.
- Remove existing Level 1 and Lower-Level floor and wall mounted heaters and associated branch piping, tees and valves as shown in the Demolition Plan.
- Remove and replace existing air intake ductwork and equipment as identified in the Plan Set.
- Provide and install two (2) condensing boilers and associated mechanical and plumbing equipment.
- Provide and install one (1) dual-fuel boiler and associated mechanical and plumbing equipment.
- Provide and install three (3) heating water pumps and associated equipment.
- Provide and install thirty (30) unit heaters and connect new piping, new insulation, and valves on branch lines on Level 1 and Lower Level of the building.
- Provide and install thirty (30) wall mounted baseboard/fin tube/convector heaters and connect new piping, new insultation and valves on branch lines on Level 1 and Lower level of the building.
- Provide and install thermostats to control heater units, including connections to building management system.

2.2 PROJECT REQUIREMENTS SUMMARY

A. Disadvantaged Business Enterprise (DBE) Participation Goal has been established for this project at **0.0%** of the Base Bid Contract Amount.

B. A Bid Bond for 5% of the Contract Amount is required for this project.

C. Performance Bond for 100% of the Contract Amount is required from the selected contractor for this project. Additional project value as added via approved change orders shall be addressed by amendment of bonds as requested by Metro Transit.

D. Labor and Material Payments Bond for 100% of the Contract Amount is required from the selected contractor for this project. Additional project value as added via approved change orders shall be addressed by amendment of bonds as requested by Metro Transit.

E. Maintenance Bond for 100% of the Contract Amount is required from the selected contractor for this project and will cover a two (2) year period from the date of Substantial Completion.

F. Contract Completion.

The Date of Substantial Completion of the Work is the date certified by written Notice that the work is 95% or more complete, with the exception of a minimal list of deficiencies, as

provided by Metro's Project Manager.

G. Wage Rates.

Federal:
The U.S. Department of Labor has established minimum wages to be paid on this project. A copy of U.S. Department of Labor (Federal) General decision is attached. In the event that there is a question regarding rate of pay applicable to laborers, the higher rate shall prevail.

H. Completion

1. The Date of Substantial Completion of the Work is the date certified by written Notice that the work is 95% or more complete, with the exception of a minimal list of deficiencies.

2. Occupancy or utilization of Completed Work, or a portion of completed work, by Metro, does not constitute Substantial Completion or Final Acceptance.

3. Contractor has no right to damages for any causes of delay by Metro Transit. Scheduling of the Work must be mutually agreed upon by Metro Transit and the Contractor before Work can commence. Metro Transit's operational requirements are paramount and shall take precedence. A request for an adjustment of time shall be forwarded in writing to Metro Transit's Project Manager as soon as the Contractor is aware of circumstances beyond the Contractor's control. Requests shall include a statement of cause and expected time delay. The Project Manager may from time-to-time award extensions to the contract time justified by delay caused by either the Contractor or Metro Transit, provided that adequate evidence is presented to enable the Project Manager to determine with exactness the extent and duration of delay for each item involved. Time may only be adjusted by Change Order.

4. The Contractor in his/her submittal of Bid Form(s) is undertaking to complete the Work within the stated and agreed contract time, has taken into consideration and made allowances for all of the ordinary delays and hindrances incident to such Work, whether because of delays in procuring equipment, materials, workers or other causes.

2.3 BID INFORMATION

A. Contacts.

Owner(s)
Regional Metropolitan Transit Authority of Omaha
2222 Cuming Street
Omaha, NE 68102

Project Manager -
Joy Hottovy Willoughby
402-341-7560 ext. 2600
jwilloughby@ometro.com

Procurement -
Lucia Del Rio Lopez
402-341-7560 ext. 2272
procurement@ometro.com

Engineer –
SRF Consulting Group, Inc.
950 South 10th Street, Suite 8
Omaha, NE 68102
402-513-2160

B. IFB Documents, Technical Specifications and Drawings are available for review at:

1. Regional Metropolitan Transit Authority of Omaha Administrative Office
   2222 Cuming Street
   Omaha, Ne 68102

2. Regional Metropolitan Transit Authority Website
   www.Ometro.com

3. StandardShare
   www.Standardshare.com

C. Pre-Bid Conference will be held at the administrative offices (2222 Cuming Street, Omaha, NE 68108) as listed in the Bid Schedule. The purpose of this conference will be to present the proposed work and field questions from attendees. Attendance is encouraged but not mandatory.

SECTION 3. BID INSTRUCTIONS

3.1 DEFINITIONS

In addition to any other term that may be defined in the IFB Documents, whenever used in the IFB Documents, the following terms shall have the following meanings:

(a) **"Bid"** means and refers to the response and offer of a Bidder submitted on the prescribed forms and in the prescribed manner setting forth, among other matters, the prices for the Work to be performed. The Bid includes the completed bid together with all other attachments, documents, instruments, forms, submissions, exhibits and schedules attached thereto or referenced therein or that is otherwise submitted or furnished (or is required to be submitted or furnished) to Metro Transit at any time by a Bidder in furtherance of its Bid in accordance with the IFB Documents or that a Bidder is required by the IFB Documents to submit or furnish to Metro Transit, including the Bid Security.
(b) **"Bidder"** means and refers to a responsible Bidder that has submitted a responsive Bid to Metro Transit.
(c) **"Bid Documents"** means and refers to all documents issued by Metro Transit in furtherance of the solicitation of Bids for the Project. The IFB Documents include: (i) the Notice of invitation to Bid (including any other advertisement or invitation to Bid and any related published information),

(ii) the IFB Documents together with all attachments, documents, instruments, forms, submissions, exhibits, and schedules attached thereto or referenced therein, including the Supplemental Conditions, Construction Drawings, and the Technical Specifications. (iii) all Addenda, (iv) all inquiries, notices, requests, forms, requests, documentation, and other matters that a prospective Bidder is required or permitted to submit in furtherance of any communication with Metro Transit (v) the Bidder's List Data Form,

(d) "**Bid Security**" by a bid bond made payable to The Regional Metropolitan Transit Authority of Omaha in the amount of five percent (5%) of the full expected Contract Amount (reflected in U.S. Dollars) for all Work

(e) **"business day"** means Monday through Friday of a calendar week other than a day that is recognized by Metro Transit as a holiday for Metro Transit's administrative personnel.

(f) **"Contract"** means and refers to the entire integrated written agreement between Metro Transit and Contractor concerning the Work and the Project. The Contract includes (i) all exhibits and schedules attached to the Contract, and (ii) all agreed to Change Orders (as defined in the Contract), each of which is or will be integrated into and made a part of the Contract. The Contract constitutes the entire agreement and supersedes all prior agreements and understandings, both written and oral, between Metro Transit and Contractor as to the subject matter of the Contract.

(g) **"Contract Documents"** means and refers to (i) the IFB Documents, (ii) the Bid, (iii) the required performance bond and labor and material payment bond [and other required bonds], (iii) the Contract and any documents, information or other items or matters designated as such in the Contract,

(h) **"Contractor"** means and refers to the Bidder that has been awarded the Contract by Metro Transit, but only if the Contract has been entered into by both Metro Transit and Contractor and all conditions applicable to the award of the Contract and as otherwise may be set forth in the Contract Documents have been fully satisfied.

(i) **"include", "included", "including"** and words of similar import shall be construed as if followed by the phrase "without limitation";

(j) **"Governmental Authority"** means and refers to any governing bodies (including any governmental (and quasi-governmental), federal, state and local subdivision or unit of such governing body, together with their respective officials, authorities, agencies, departments and divisions) that has jurisdiction, whether in whole or in part, over any matter that, at any time, may relate to or pertain to any matter to which any Governmental Requirement may govern or apply. Governmental Authority includes the United States Department of Transportation ("**DOT**") and the Federal Transit Administration ("**FTA**").

(k) "**Governmental Requirement**" means any requirement of any Governmental Authority that is, or that may become, effective or applicable at any time to the any of the IFB Documents, the Contract Documents, the Project, the Work or Contractor's performance under and in respect of the Contract, including all Laws and Regulatory Approvals of any Governmental Authority and all regulations, rules, orders, directives and standards and other requirements all regulations, rules, orders, directives and standards and other requirements issued or promulgated thereunder that Metro Transit may be at any time be required to implement, observe, execute, follow or adhere to, whether by application of the provisions of the applicable Master Agreement between Metro Transit and the FTA ("Master Agreement"), any Laws or Regulatory Approvals or otherwise;

(l) "**Law(s)**" means all statutes, laws, codes, ordinances, regulations, rules, orders, directives and standards of any Governmental Authority, that may be in effect or that may be or that may become applicable at any time to the any of the IFB Documents, the Contract Documents, the Project, the Work, the Contract or Contractor's performance under and in respect of the Contract. Laws includes all Environmental Regulations and the Federal Transportation Act and all regulations, rules, orders, directives and standards and other requirements issued or promulgated thereunder;

(m) **"Project"** means Boilers Replacement, Project, PROJECT NO.: NE-90-X144; "Project" is sometimes used interchangeably with "Work" and, if so, shall be ascribed that definition;

(n) "**Regulatory Approval**" means any and all approvals, licenses, permits, consents, registrations or authorizations, certificates, forms and licenses of any Governmental Authority that may be in effect or that may be or that may become applicable at any time to the IFB Documents, the Contract Documents, the Work, the Project or Contractor's performance under or in respect of the Contract;

(o) "**Representative**" means and refers to SRF CONSULTING GROUP, INC., 950 South 10th Street, Suite 8, Omaha, NE 68102; and

(p) "**Work**" means and refers to all supervision, direction, employees and other labor, all materials, supplies, services, work, machinery, transportation, tools, equipment, plant required for set-up of general plant, storage/staging areas and facilities, and all other tasks and incidentals necessary to fabricate, construct, assemble, install and otherwise perform and complete the Project, the Work and the Contract as and when required and otherwise in conformity with the Contract Documents.

3.2 RESERVATIONS

A. Metro Transit reserves the right to waive informalities or irregularities in bids, to accept or reject any or all bids, to cancel this IFB in part or in its entirety, and to re-advertise for bids if it is in the best interest of Metro Transit.

B. Metro Transit reserves the right to request a Bidder to replace a Subcontractor if the Subcontractor has failed to pay, or satisfactory settle, any amount to due for labor and materials in connection with a current contract with Metro Transit as of the Submission Deadline; or the Subcontractor was declared to be in default in any previous contract with Metro Transit that was not resolved to the reasonable satisfaction of Metro Transit or whose work in a prior contract with Metro Transit was otherwise found by Metro Transit to be deficient or otherwise not satisfactory, as reasonably determined by Metro Transit.

C. This solicitation for Bids shall not be considered to be an offer to award the Contract. This solicitation may be amended, modified, withdrawn, or canceled by Metro Transit at any time for any reason or for no reason. Whether or not Metro Transit amends, modifies, withdraws, or cancels this invitation, Metro Transit is not responsible for any cost or expense that may be incurred by any Bidder incurred prior to the execution of the Contract, including any costs associated with preparing a Bid. No Bid shall be considered binding upon Metro Transit unless (i) a Contract first has been awarded by its Board of Directors at a public meeting, (ii) the Contract has been duly executed by each of the Contractor and Metro Transit, and (iii) all conditions applicable to such award of the Contract and as otherwise may be set forth in the Contract Documents have been fully satisfied. Metro Transit reserves the right to withdraw or cancel the award of the Contract for any reason or no reason without liability. In the event of the withdrawal or cancellation of this invitation or the award of the Contract, the Bid Security of each Bidder shall be released and returned by Metro Transit.

3.3 BIDDER'S RESPONSIBILITIES

A. Without prejudice or limitation to any other representation required to be made or otherwise made by Bidder with its Bid, the submission of its Bid constitutes a representation by Bidder that,

1) Bidder has read and understands the IFB Documents, and the Bid is made in accordance with all requirements of the IFB Documents;
2) Bidder possesses the capabilities, resources, and personnel necessary to perform the Work in accordance with the Contract Documents;
3) Bidder is duly organized and existing under and by virtue of the Laws of the state of its organization and has the power to transact business in the State of Nebraska;
4) Bidder has all power, authority and capacity under all applicable Laws and under its organizational and constituent documents to enter into and to perform under and in respect of the Contract;
5) The Bid has been duly authorized, executed and delivered by Bidder;
6) Bidder has read and thoroughly examined the IFB Documents and has a complete understanding of the terms and conditions required for the full and complete performance of the Work in conformity with the Contract Documents;
7) Before submitting its Bid, Bidder has made all investigations and examinations necessary to ascertain the character, location and other conditions and requirements pertaining to the Work site and the Work that it has determined may affect in any way its full and complete performance of the Work in conformity with the Contract Documents;
8) Bidder has found no errors, conflicts, ambiguities or omissions in any of the IFB Documents;
9) Bidder is familiar with all applicable Governmental Requirements applicable to the Project, the Work, the Contract and Bidder's required performance (as Contractor) under and in respect of the Contract;
10) To the best of Bidder's knowledge, after due and diligent investigation and inquiry,
    a. No member of Metro's Board of Directors nor any of Metro Transit's officers or employees is employed by, or has a financial interest, direct or indirect, in the Bid, the contemplated Contract, the Bidder or any Subcontractors,
    b. No gratuities have been offered or given by or on behalf of Bidder with an intent to secure the Contract, and
    c. Neither the award of the Contract to the Bidder nor its performance (as Contractor) under or in respect of the Contract will result in any conflict of interest that is prohibited under any Governmental Requirement, including any such conflict referenced or described in the Master Agreement or in Section 16 (g) or Chapter III (1) of FTA Circular 4220.1G.

3.4 IDENTIFICATION OF BIDDER

With its Bid, Bidder must separately be identified fully and completely in an attachment to its Bid referencing this Paragraph 3.4, whether a natural person/individual, partnership (general or limited), corporation, limited liability company, association, or other form of business organization (whether or not regarded as a legal entity under Applicable Law), trust, estate or any other entity. If an individual doing business under a fictitious name submits a Bid, the Bid should so state. If a Bid is made by a partnership or a limited liability company, the full names and addresses of all members of the partnership or limited liability company must be given. In the case of a partnership, a general partner must sign the Bid. In the case of a limited liability company, the manager or authorized member must sign the Bid. If a corporation makes the Bid, an authorized officer must sign the Bid. If the Bid is made by a joint venture, the full names and addresses of all members of the joint venture must be given and one authorized member should

sign the Bid. If applicable, a copy of the partnership/joint-venture agreement/operating agreement shall be included as an attachment to the Bid. Each Bid shall be made in the name of the Bidder, dated, and signed with an ink pen by the appropriate individual, whose name and title also shall be printed or legibly written. Signatures shall be accompanied by the address (including city, State, and zip code) and the telephone number of the Bidder. If the Bid has been submitted by an agent of Bidder, evidence of the power of attorney must be attached to the Bid. Metro Transit reserves the right to verify the status of the signatory.

3.5 FIRM BIDS AND BID SECURITY

All Bids shall remain firm (and may not be withdrawn without forfeiture of the Bid Security for no less than ninety (90) days after the date of the Bid Submittal Date. Each Bid must be accompanied by a Bid Security. The Bid Security shall be written by a licensed surety firm authorized to do business in the State of Nebraska. A current power of attorney for the person signing the bond as a representative of the surety must be attached to the Bid Security. The Bid Security must be issued by a surety authorized to do business in the State of Nebraska that is listed in the current issue of the most recent revision of the United States Treasury Circular 570. Failure to submit the Bid Security will result in the Bid being considered non-responsive. It is anticipated that Metro will award a Contract for the Project no later than thirty (30) days after the Bid Submittal Date. Metro reserves the right to extend the date to award the Contract by issuing an Addendum for such purposes, notice of which shall be sent to all Bidders whose Bid then has not been rejected by Metro Transit. However, if so extended by Metro Transit, any Bidder may elect to withdraw its Bid by written notice to Metro ("**Propose Notice of Withdrawal of Bid**"), but only if such notice has been received by Metro no later than 4:30 p.m. on the date that is three (3) days after the date of the issuance of the Addendum extending the anticipated date to award the Contract, in which event the Bid Security promptly shall be returned to the Bidder and the Bidder's Bid will no longer be eligible for consideration. If Metro Transit issues any such Addendum, then notwithstanding anything contained in the IFB Documents to the contrary, except when a Bidder has withdrawn its Bid in accordance with paragraph 3.5, or Metro has released the Bid Security of a Bidder in writing, the Bid Security of a Bidder shall remain firm (and may not be withdrawn without forfeiture of the Bid Security) until the Contract is executed and all conditions to the award of the Contract have been fully satisfied.

3.6 CONTRACTOR RESPONSIBLE FOR ALL WORK/PERFORMANCE; MINIMUM CONTRACTOR PARTICIPATION

Contractor shall be responsible for all performance undertaken or required under or in respect of the Contract, including the performance of all Work and providing all services, equipment, facilities, and functions which are necessary for the safe, reliable, efficient, and well-managed operation of the Project, the Work and the Contract consistent with established industry practices, whether or not those services, equipment, facilities, and functions are specifically required by the terms of the Contract or in any IFB Document. Notwithstanding Contractor's use of any Subcontractors, Contractor shall have a minimum participation level of not less than thirty percent (30%) of the Contract Amount.

3.7 COMMUNICATION WITH METRO TRANSIT

A. General Inquiry. Other than as otherwise expressly required in this paragraph 3.7(A) any inquiry

(other than those made at the Pre-Bid Conference) relating to the IFB Documents, the Project or the Work must be made in writing to the Procurement Manager and must be received by Metro no later than **March 24, 2026, at 2:00 pm CST**. Each inquiry must refer to the Project by name and submitted on the Request for Clarification Form Provided in the IFB Documents. Metro Transit will issue a response to any such request by written Addendum.

B. Errors and Discrepancies in IFB Documents. If a Bidder believes that there may exist an error, discrepancy, ambiguity, or omission in any IFB Document, then prior to the submission of its Bid, Bidder must notify the Procurement Manager of the same by written notice on the Request for Clarification Form. By submission of its Bid, Bidder represents there exists no error, discrepancy, ambiguity, or omission in any of the IFB Documents that would change the cost, progress or performance of the Work. Metro Transit will review, evaluate, and respond in the same manner as any other inquiry made pursuant to the IFB Documents. Whether or not approved, Metro Transit will issue a response to Bidder's inquiries by written Addendum.

C. Requests for Approved Equals, Product Options and Substitutions**.** Wherever brand, manufacturer, or product names are used in respect of the Work, they are included only for the purpose of establishing a description of minimum quality of the requested item unless otherwise specified in the specifications or other IFB Documents. This inclusion is not to be considered as advocating or prescribing the use of any particular brand or item or product. Prospective Bidders may discuss the specifications and related matters with the Procurement Manager; however, any requests for approved equals or other substitutions must be made to the Procurement Manager in writing by use of the "**Request for Substitutions/Approved Equals**" form included in the IFB Documents, which must be received by Metro Transit no later than **March 24, 2026, at 2:00 pm CST.** When an approved equal is requested, if so requested by Bidder, the prospective Bidder must demonstrate the quality of its alternative product to Metro Transit and furnish sufficient technical data, test results, etc., to enable Metro Transit to determine whether the product is or is not equal to specification required by the IFB Documents. Whether or not approved, Metro Transit will issue a response to a Request for Substitutions/Approved Equals by written Addendum. The Contract will provide that Metro Transit may reject any request by Contractor following the award of a Contract for a substitute or qualified equal, in its Metro Transit's sole judgment and absolute discretion.

D. Modifications to Bids; Withdrawal of Bids. Any Bidder that has submitted a Bid may modify or withdraw its Bid at any time prior to the Submission Deadline. Withdrawal of a Bid may be made only with written confirmation under signature of the Bidder. Withdrawal of a Bid will not prejudice the right of any Bidder to submit a new Bid in its own name or in combination with another Bidder, provided that the new Bid is received by Metro Transit as of the Submission Deadline. Modifications to a Bid and requests to withdraw a Bid received by Metro Transit after the Submission Deadline will have no effect and will be returned unopened.

E. Submission by Prospective Bidders**.** For avoidance of any doubt, all inquiries, notices, requests, forms, documentation, and other matters that a prospective Bidder is required or permitted to submit in furtherance of any communication with Metro Transit pursuant to this paragraph 3.7(E) must be made in the name of the prospective Bidder.

F. Addendum; Metro Initiated Addendum; Bidder Responsibility. No verbal or written instructions or interpretations in respect of the IFB Documents, the Contract Documents or the Project will have effect or validity regardless of source unless made in the name of the Procurement Manager in the form of a written Addendum. Complete copies of each related form, inquiry, request or

submission etc. made pursuant to this paragraph 3.7(F), together with the corresponding Addendum (and any other Addendum contemplated by the IFB Documents) will be available for inspection at Metro Transit's Administrative Offices and online at the following links http://www.standardshare.com and www.ometro.com . Nothing in the IFB Documents shall be construed to restrict Metro Transit from issuing any Addendum at any time or at its own initiation. Notwithstanding anything contained in the IFB Documents to the contrary, it is the responsibility of the Bidder to obtain copies of all issued Addenda. Bidder is required to acknowledge on the form and manner required by the IFB Documents that it has received all issued Addenda, and failure to do so will cause the Bid to be deemed non-responsive.

3.8 PROTEST

1. Pre-bid approval requests and appeals.

a. Bid documents issued by the Authority shall contain provisions and instructions to bidders relative to the submission of requests for clarification, substitutions and approved equals on specified materials and equipment. All such requests shall be submitted in writing in a timely manner before the date of the bid opening and in accordance with the schedule stipulated in each bid document. Failure to submit requests on the specifications as stipulated above constitutes waiver of all rights to appeal on that basis.
b. All such requests shall be submitted in writing to the Manager of Procurement and Contracts and supported by sufficient documentation, specifications, engineering data and test data to enable evaluation of the request.
c. If such request is accepted and approved, all holders of bid documents will be notified by written addenda to the bid documents.
d. If a request is denied, all holders of bid documents will be notified by written addenda to the bid documents.
e. A request denied by the Procurement Manager may be appealed in writing to the CEO/Executive Director prior to the date set for receipt of bids or proposals. The appeal shall include a copy of the Procurement Manager's decision and all data submitted with the original request. If new or additional data is available, the request shall be submitted to the Procurement Manager for reconsideration. If the appeal of the Procurement Manager's decision or request for reconsideration will delay the bid opening, a new bid opening date shall be announced to all bid document holders by written addenda to the bid documents.

2. Contract Award Appeals

a. Appeal of a contract award or announced intent to award must be filed in writing with the CEO/Executive Director not later than ten (10) days after the award or announced intent to award, whichever is earlier. When appeal of a contract award is filed, the successful firm shall be notified in writing. Appropriate instructions shall be given according to the status of the contract and the effect of delay of the project completion.
b. Appeal of the CEO/Executive Director's decision may be made in writing to the Authority Board within five (5) days of the receipt of such decision. Written notice of the appeal shall be provided to the Executive Director.

3. Protest of Procurement Process

a. A protest of the procurement process of the Regional Metropolitan Transit Authority of the Omaha should be submitted in writing to the CO/Executive Director and supported by justification

and requested corrective action.

b. Appeal of the CEO/Executive Director's decision will be the same as 2.b. above

4.FTA Review of Protests and Appeals

A. General Conditions

a. FTA's review of any protest shall be limited to:
   i. Failure of the grantee to have written protest procedures.
   ii. Grantee's failure to follow such procedures.

b. Protests must be filed with the grantee in accordance with the local procedures and requirements. Following an adverse decision by the grantee, the protester may file a protest with FTA in accordance with paragraph 2 below. If there has been a violation as described in paragraph 1.a.i. or 1.a.ii. above, protests should be filed with the appropriate FTA Regional Office and concurrent copy to the grantee. To expedite handling within FTA, the address should include, "Attention — Bid Protest".
   The address of the appropriate FTA Regional Office is: Federal Transit Administration 901 Locust Street, Suite 404 Kansas City, Missouri 64106

c. The initial protest filed with FTA shall:
   i. Include the name and address of the protester
   ii. Identify the grantee, project number, and the number of the solicitation contract
   iii. Contain a statement of the grounds for protest and any supporting documentation. (The grounds for protest filed with FTA must be fully supported to the extent feasible. Additional materials in support of an initial protest will only be considered if filed within the time limits specified in paragraph 2).
   iv. Include a copy of the protest filed with the grantee, and a copy of the grantee's decision, if any.
   v. Indicate the ruling or relief desired from FTA.

d. FTA will not consider any data that was not submitted to the grantee. If new data becomes available after the exhaustion of administrative remedies as the grantee level, that data should be filed with the grantee with a request for reconsideration. If the request is denied or if the protester's administrative remedies at the grantee level are again exhausted, the protester may then submit the new data to FTA. FTA will consider the data if filed as part of the initial protest within the time limits specified in paragraph 2, or as additional material filed within the time limits specified in paragraph 3.

e. No formal briefs or other technical forms of pleading or motion are required, but a protest and other submission should be concise, logically arranged, and clear.

2. Time for Filing

a. Protests shall be filed within the specified time limits set forth in the specifications which are the subject of the procurement and must adhere strictly to any procedures specified therein. The time period established for the filing of protests as set forth in all such specifications will be controlling and will take precedence over a time period established herein.

b. Protests must be filed within the time limits set forth in this paragraph b. in order to be

considered timely unless the specifications which are the subject of a particular procurement set forth a different period for filing a protest, in which case the provisions of paragraph a. above will apply. Protests based upon restrictive specifications or alleged improprieties in any type of solicitation, which are apparent prior to bid opening or the closing date for receipt of initial proposals, shall be filed no later than three (3) days prior to bid opening or the closing date for receipt of initial proposals.

c. In cases other than those covered in the preceding paragraphs of this section, bid protest shall be filed not later than ten (10) days after the exhaustion of administrative remedies at the grantee level is known or should have been known, whichever is earlier.

3. Time for Submission of Additional Information

Any additional information requested or required by FTA from the protester, the grantee or interested parties shall be submitted as expeditiously as possible, but in no case later than five (5) days after receipt of such request unless specifically excepted by FTA.

3.9 DISCLOSURE OF PROPRIETARY INFORMATION.

A. By submission of its Bid, a Bidder acknowledges that Metro Transit is a public body to which Laws of the State of Nebraska governing the disclosure of public records (Neb. Rev. Stat. 84-712 to 84-712.09, inclusive; "Public Records Statutes") have application. A Bidder may attempt to restrict the disclosure of scientific and technological innovations in which it has a proprietary interest, or other information that is protected from public disclosure by Law contained in the Bid by:

1) marking each page of each such document prominently in at least 16-point font with the words "Proprietary Information",
2) printing each page of each such document in a different color paper than the paper which the remainder of the bid is printed; and
3) segregating each page of each such document in a sealed envelope, which shall prominently display, on the outside, the words "Proprietary Information" in at least 16-point font, along with the name and address of the Bidder.

If access to documents marked "Proprietary Information" (and otherwise complying with (1) through (3) above), is requested pursuant to the Public Records Statutes, Metro Transit will notify the Bidder of the request. The Bidder shall have the burden to establish that such documents are exempt from disclosure under the Public Records Statutes, and Metro Transit shall not be responsible to undertake any act or action to prevent any such disclosure. Notwithstanding the foregoing, Metro Transit reserves the right to release any documents requested pursuant to the Public Records Statutes if Metro determines that such information is a public record under the Public Records Statutes.

SECTION 4. BID SUBMISSION, EVALUATION AND AWARD

4.1 BID SUBMITTAL REQUIREMENTS

A. Bids must be received with all required submittals as stated in the IFB, no later than **April 8, 2026, at 2:00 pm Central Standard Time**, at which time they will be publicly opened, read and tabulated by Metro Transit at Metro Transit's Administrative Offices Board Room located

at 2222 Cuming Street, Omaha, NE 68102. Metro prefers Bids be submitted via Mail or hand delivery. The upper-left hand corner of the sealed enveloped must identify the following information:

(Name of Contractor/Bidder)
Sealed Bid for project:
BOILERS REPLACEMENT
NE-90-X144, Spec. 04-26

B. Bids received after the time specified shall not be considered for award. Bids received via facsimile (fax) or electronic mail (e-mail) shall not be considered. Bids not meeting specified delivery and method of submittal will not be opened nor considered responsive.

C. Bids must be addressed and delivered to Metro Envelopes, containing bids must be sealed and addressed to:

The Regional Metropolitan Transit Authority of Omaha Metro
Attn: Procurement and Contracts Manager
BOILERS REPLACEMENT 04-26
2222 Cuming St
Omaha NE 68102-4392

D. A Proposal Form with BID Form has been provided in Division 2. **DO NOT DEVIATE FROM THE USE OF THIS FORM.**

1. The costs included in the bid should include all items of labor materials, and other costs necessary to perform the contract further explained in Division 3 – Supplemental Conditions. Transportation costs, offloading, installation and other costs associated with the delivery and ultimate installation of work should be included in price bid. Any items omitted from this IFB which are clearly necessary for the completion of the work being proposed should be considered part of the work though not directly specified or called for in this IFB.

2. Bidder understands that pay applications submitted for this project work shall identify subcontractors, if applicable, the amount of payment to the subcontractor for each pay application period as well as cumulative total paid to the subcontractor for the term of the contract. If subcontractor is certified as Disadvantaged Business Enterprise (DBE) this shall be identified on the Subcontractor Utilization Form submitted with each monthly payment application.

4.2 CONTRACT AWARD

A. Form of Contract

Metro anticipates awarding a firm fixed price (lump sum based upon aggregate of all unit prices) contract substantially in the form of AIA Contract A-101 Standard Form of Agreement between Owner and Contractor, 2017 Edition and AIA Document A-201, 2017 General Conditions, in all cases modified as may be necessary or appropriate, as determined by Metro Transit in its sole judgment and absolute discretion, to integrate (i) all Contract Documents, (ii) all requirements and all conditions of Metro Transit in respect of the Project, the Work and

the Contract, (iii) all requirements and conditions of any Governmental Authority having jurisdiction over any matters pertaining to Project, the Work or the Contract and Contractor's performance under and in respect of the Contract, including all Governmental Requirements, (iv) the Representative's role as construction manager and as Metro Transit's representative on all matters in respect of the Project, the Work or the Contract and Contractor's performance under and in respect of the Contract, (v) all provisions of this invitation stated to be made a part of the Contract; and (vii) such other modifications that Metro Transit may determine to be in its best interest as necessary or appropriate to assure completion of the Project and the Work in accordance with the Bid and the other Contract Documents. The successful Bidder will be required to execute the Contract within thirty (30) days after the award of the Contract by Metro Transit. Failure to execute the Contract within the specified time frame may result in the cancellation of the award of the Contract to such Bidder and will result in the forfeiture of the Bidder's Bid Security.

B. Notice of Intent to Award the Contract

It is the intent of Metro Transit that, following a period of review of the Bids and an evaluation of the Bidders, a firm fixed price (lump sum of aggregate of unit prices) contract will be awarded to the responsible Bidder whose Bid complies with all of the Bid Documents and is lowest in price. The successful Bidder will be informed that its Bid has been accepted and of Metro Transit's intent to award the Contract to such Bidder by issuance of a Notice-of Intent to Award the Contract, a copy of which shall be contemporaneously sent by Metro Transit to all responsive Bidders to the address designated in their respective Bid. The Notice-of-Award shall not be construed to be binding on Metro Transit unless (i) a Contract first has been awarded by its Board of Directors at a public meeting, (ii) the Contract has been duly executed by each of the Contractor and Metro Transit, and (iii) all conditions applicable to such award of the Contract and as otherwise may be set forth in the Contract Documents have been fully satisfied.

C. Certifications by Bidder

1. Debarment

a. Bidder must certify that is not included in the "U. S. General Services Administration's List of Parties Excluded from Federal Procurement or Non-Procurement Programs." Bidder must include a completed certification in the form attached in Division 2 of the IFB Documents.

b. Bidder agrees to refrain from awarding any Subcontractor of any amount (at any tier) to a debarred or suspended subcontractor. Bidder must include with its Bid a completed certification in the form attached in Division 2 of the IFB Documents from each Subcontractor (at any tier) seeking a contract exceeding $25,000.

c. Bidder agrees to provide Metro Transit with a copy of each conditioned debarment or suspension certification provided by a prospective Subcontractor at any tier, and to refrain from awarding a subcontract with any party that has submitted a conditioned debarment or suspension certification until FTA approval is obtained.

2. Lobbying

a. Pursuant to Public Law 104-65, the Bidder is required to certify that no Federal funds were used to influence or attempt to influence an officer or employee of any Federal department or agency, a member of Congress or State legislature, an officer or employee of Congress or State legislature, or an employee of a member of Congress or State legislature regarding the project(s) included in this contract.

b. Bidders who use non-Federal funds for lobbying on behalf of specific projects or bids must submit disclosure documentation when these efforts are intended to influence the decisions of Federal officials. If applicable, Standard Form-LLL, "Disclosure Form to Report Lobbying", is required with the Bidder's first submission initiating the Metro's consideration for a contract. Additionally, Disclosure forms are required each calendar quarter following the first disclosure if there has been a material change in the status of the previous disclosure. A material change includes: 1) a cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; 2) a change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or 3) a change in the officer(s) or employee(s) or Member(s) contacted to influence or attempt to influence a covered Federal action.

c. The Bidder is required to obtain the same certification and disclosure from all subcontractors (at all tiers) when the Federal money involved in the subcontract is $100,000 or more. Any disclosure forms received by the Bidder must be forwarded to Metro.

3. Employee Eligibility Verification

a. The Bidder is required by sworn affidavit and provision of documentation, to affirm its enrollment and participation in a Federal work authorization program with respect to employees working in connection with the contracted services.

b. The Bidder shall also affirm that it does not knowingly employ any person in connection with the contracted services who does not have the legal right or authorization under Federal law to work in the United States as defined in 8 U.S.C. §1324a(h)(3).

c. The Bidder is required to obtain the same affirmation from all subcontractors at all tiers.

4. Buy America

The Bidder agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7.

The Bidder must submit to Metro Transit the appropriate Buy America certification with its Bid. Bids that are not accompanied by a completed Buy America certification found in Division 2 of this solicitation will be rejected as nonresponsive.

4.3 BASIS FOR CONTRACT AWARD

A. Prior to the issuing Notice-of Intent to Award the Contract, Metro Transit will review the Bid to ensure the Bid is deemed responsive and meets the requirements of the IFB Documents. Without limitation to any other Governmental Requirement, to be determined "responsible", a Bidder must possess at the time of the award of the Contract the ability to perform successfully and a willingness to comply with the terms and conditions of the Contract, including (i) the financial resources adequate to perform the Contract, or the ability to obtain them; (ii) the ability to meet the required delivery or performance schedule, taking into consideration all existing commercial and governmental business commitments; (iii) a satisfactory performance record; (iv) a satisfactory record of integrity and business ethics; (v) the necessary organization, experience, accounting, and operational controls, and technical skills, or the ability to obtain them;(vi) compliance with applicable licensing and tax laws and regulations; (vii) the necessary production, construction, and technical equipment and facilities, or the ability to obtain them; (viii) compliance with Affirmative Action and Disadvantaged Business Program requirements; and (ix) any other qualifications and eligibility criteria necessary to receive an award under any Governmental Requirement.

   Notwithstanding anything contained in the IFB Documents to the contrary and without limitation to any additional right of Metro Transit in respect of such matters, Metro Transit reserves the right to deem any Bidder as not responsible if: such Bidder has failed to comply with any requirements of the IFB Documents, including any pre-qualification requirements cited therein as a requirement or condition of the submission of a Bid; whether the Bidder has failed to pay, or satisfactory settle, any amount to due for labor and materials in connection with a current contract with Metro Transit as of the Submission Deadline; or the Bidder was declared to be in default in any previous contract with Metro Transit that was not resolved to the reasonable satisfaction of Metro Transit or whose work in a prior contract with Metro Transit was otherwise found by Metro Transit to be deficient or otherwise not satisfactory, as reasonably determined by Metro Transit.

4.4 BONDING REQUIREMENTS (CONSTRUCTION AND FACILITY IMPROVEMENTS)

B. A bid bond in the amount of five percent (5%) of the full expected cost of services to be performed, reflected in U.S. dollars, must be enclosed in the bid envelope.

C. The bond must be written by a licensed surety firm. Failure to submit a bond with the bid will result in the bid being considered non-responsive.

D. As a condition to the Contract, the successful Bidder will be required to furnish a performance bond, maintenance bond, and a separate labor and material payment bond, each in the amount of 100% of the Contract Amount (reflected in United States Dollars), each made payable to the Regional Metropolitan Transit Authority of Omaha. The Contract will require that each bond shall be delivered to Metro Transit contemporaneously with Contractor's execution of the Contract and cannot be dated prior to the date of the award of the Contract The performance bond shall be security for Contractor's full and faithful performance of the Contract. The labor and material payment bond shall be security for Contractor's payment of all persons, firms or corporations to whom Contractor may be liable for labor, materials, tools, equipment and other services in respect of the performance of the Work and as may otherwise be required by Neb. Rev. Stat Section 52-118. A maintenance bond will also be

required for a two (2) year period from the date of Substantial Completion. The form of each bond must be that provided within the IFB.

E. Bonds shall be issued by a surety authorized to do business in the State of Nebraska that is listed in the current issue of the most recent revision of the United States Treasury Circular 570. The bonds, for the life of the Contract, shall be maintained to reflect additional values incorporated by approved Change Orders. A current power of attorney for the person signing the bond as a representative of the surety must be attached to the bonds. If specifically requested by Metro, the successful Bidder shall obtain and submit information on the surety's financial strength rating.

4.5 INSURANCE REQUIREMENTS

It is strongly recommended that Contractor confer with their respective insurance carriers and/or brokers to determine in advance of proposal submission the availability of insurance coverage as required under this solicitation. Failure to comply with the insurance requirements may result in disqualification from award of the contract. Compliance with insurance requirements hereunder is considered a material term of the contract.

Contractor shall procure and maintain for the period set forth below insurance against claims for injuries to persons or damage to property or for professional errors and omissions which may arise from or in connection with the performance of the work here under by the Contractor, Contractor's agents, representatives, employees or sub-contractors. Metro Transit reserves the right to alter, amend, increase or otherwise modify the insurance requirements stated herein.

A. **Commercial General Liability Insurance** including Personal Injury Liability, Independent Contractor's Liability, Contractual Liability, Product Liability, and Completed Operations Liability

Limits

$1,000,000 General Aggregate Limit

$500,000 Products/Completed Work Limit

$500,000 Each Occurrence Limit

$300,000 Fire Damage Limit (any one fire) $5,000 Medical Payments Limit (any one person).

B. Garage Keepers Liability (Optional)

$1,000,000 General Aggregate Limit

$500,000 Each Occurrence Limit

C. Business Automobile Liability Insurance

Combined Single Limit

$1,000,000 Each Occurrence

D. Excess Liability, Umbrella Insurance Form

Limits

(BI and PD combined) – $500,000

Each Occurrence Limit – $500,000

General Aggregate Limit - $500,000

E. Workers Compensation and Employer's Liability

Limits

$100,000 each accident for bodily injury by accident;
$100,000 each employee for bodily injury by disease;
$500,000 policy limit for bodily injury by disease.

The types and levels of insurance stated herein shall provide coverage for this job only, i.e., *Event Excess Coverage*. Consult your insurance agent for details.

Certificates of Insurance shall evidence the Regional Metropolitan Transit Authority of Omaha as an additional insured and shall be due to the Regional Metropolitan Transit Authority of Omaha within ten (10) business days after receipt of the Notice of Intent to Award. Failure to maintain or provide evidence of adequate insurance coverage shall result in Termination for Default by the Regional Metropolitan Transit Authority of Omaha.

SECTION 5. FEDERAL TRANSIT ADMINISTRATION (FTA) CLAUSES—CONSTRUCTION CONTRACTS

1. INCORPORATION OF FEDERAL TRANSIT ADMINSTRATION (FTA) TERMS

1.1 Any Contract shall include, in part, certain standard terms and conditions required by the U.S. Department of Transportation (DOT), whether or not expressly set forth in the provisions this Contract. All contractual provision required by the DOT, as set forth in the FTA Circular 4220.1G, as amended, are hereby incorporated by reference. All FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Contract. Contractor shall not perform any act, fail to perform any act, or refuse to comply with any requests of Metro that would cause Metro to be in violation of the FTA terms and conditions. Further, Contractor agrees to comply with these FTA Construction Contract Clauses as set forth and incorporated in this Contract.

1.2 Contractor shall include the above paragraph 1.1 in each subcontract under this Contract, modified only to identify the subcontractor that will be subject to the provisions.

2. NO FEDERAL GOVERNMENT OBLIGATION TO THIRD PARTIES

2.1 Metro and the Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying Contract, absent the express written consent of the Federal Government, the Federal Government is not a Party to this Contract and shall not be subject to any obligations or liabilities to Metro, Contractor or any other Party (whether or not a Party to this Contract) pertaining to any matter resulting from the underlying Contract.

2.2 Contractor shall include the above paragraph 2.1 in each subcontract under this Contract, modified only to identify the subcontractor that will be subject to the provisions.

3. PROGRAM FRAUD & FALSE OR FRAUDULENT STATEMENTS OR RELATED ACTS

3.1 Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. § 3801 *et seq.* and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 C.F.R.

Part 31, apply to its actions pertaining to this FTA federally assisted project. Upon execution of the Contract, Contractor certifies or affirms that truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying Contract or the FTA assisted project for which the work is performed. In addition to other penalties that may be applicable, Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986, as amended, on Contractor, to the extent the Federal Government deems appropriate.

3.2 Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under any contract or agreement connected with any project that is financed in whole or in part with assistance originally awarded by FTA under the authority of 49 U.S.C. §5307, the Federal Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5323(l) on Contractor, to the extent the Federal Government deems appropriate.

3.3 Contractor shall include the above paragraphs 3.1 and 3.2 in each subcontract under this Contract, modified only to identify the subcontractor that will be subject to the provisions.

4. ACCESS TO RECORDS, REPORTS, AND SITES

4.1 Record Retention. Contractor shall retain and will require its subcontractors of all tiers to retain, complete and readily accessible records related in whole or in part to the Contract, including, but not limited to, data, documents, reports, statistics, sub-agreements, leases, subcontracts, arrangements, other third party agreements of any type, and supporting materials related to those records.

4.2 Retention Period. Contractor shall comply with the record retention requirements in accordance with 2 C.F.R. § 200.333. Contractor shall maintain all books, records, accounts, and reports required under this Contract for a period of not less than three (3) years after the date of termination or expiration of this Contract, except in the event of litigation or settlement of claims arising from the performance of this Contract, in which case records shall be maintained until the disposition of all such litigation, appeals, claims or exceptions related thereto.

4.3 Access to Records. Contractor shall provide sufficient access to the U.S. Secretary of Transportation, the Comptroller General of the United States, FTA and its designated contractor(s) or agent(s), Metro and their duly authorized representatives to inspect and audit records and information related to the performance of this Contract as reasonably may be required. Contractor shall permit any of the foregoing parties to reproduce by any means whatsoever or to photocopy such records as are reasonably necessary.

4.4 Access to the Sites of Performance. Contractor shall permit FTA and its designated contractor(s) or agent(s), Metro and their duly authorized representatives access to the sites of performance under this Contract as reasonable may be required.

4.5 Contractor shall include the above paragraphs 4.1, 4.2, 4.3 and 4.4 in each subcontract under this Contract, modified only to identify the subcontractor that will be subject to the provisions.

5. CHANGES IN FEDERAL REQUIREMENTS

Contractor shall at all times comply with all applicable federal laws, regulations, requirements, policies, procedures, guidance, and directives, including without limitation those listed directly or by reference in the Master Agreement between Metro and FTA, as they may be amended or promulgated from time to time during the term of this Contract. Contractor's failure to so comply shall constitute a material breach of this Contract.

6. CIVIL RIGHTS

Under this Contract, Contractor shall at all times comply with the following requirements and shall include these requirements in each subcontract entered into as part thereof:

6.1 **Nondiscrimination**

6.1.1 Nondiscrimination in Employment. In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. §2000d et seq., Section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. §6102, Section 202 of the Americans with Disabilities Act of 1990, as amended, 42 U.S.C. § 12132, and Federal Transit Laws at 49 U.S.C. § 5332, the Contractor shall prohibit discrimination against any employee or applicant for employment because of race, color, national origin, disability, sex, or age. In addition, Contractor agrees to comply with applicable federal implementing regulations and other implementing requirements FTA may issue.

6.1.2 Contractor shall follow: (a) the most recent edition of FTA Circular 4702.1, "Title VI requirements and Guidelines for Federal Transit Administration Recipients," to the extent consistent with applicable federal laws, regulations, requirements, and guidance; (b) U.S. Department of Justice, "Guidelines for enforcement of Title VI, Civil Rights Act of 1964," 28 C.F.R. §50.3; and (c) all other applicable federal laws, regulations, requirements, orders, or guidance that may be issued during the term of this Contract.

6.2 **Equal Employment Opportunity (EEO)**

6.2.1 Race, Color, Religion, National Origin, Sex. In accordance, with Title VII of the Civil Rights Act of 1964 as amended, 42 U.S.C. § 2000e et seq., and Federal Transit Laws at 49 U.S.C. § 5332, FTA Circular 4704.1

6.2.2 Age. In accordance with the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. §§ 623, U.S. Equal Employment Opportunity Commission (EEOC) regulations, "Age Discrimination in Employment Act," 29 C.F.R. Part 1625, the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6101 et seq., U.S. Health and Human Services regulations "Nondiscrimination on the Basis of Age in Programs or Activities Receiving Federal Financial Assistance," 45 C.F.R. Part 90, and Federal Transit Laws at 49 U.S.C. § 5332, Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, Contractor agrees to comply with any implementing requirements FTA may issue.

6.2.3 Disabilities. In accordance with Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C. § 794, the Americans with Disabilities Act of 1990, as amended, 42 U.S.C. § 12101 et seq., the Architectural Barriers Act of 1968, as amended, 42 U.S.C. §4151 et seq., and Federal Transit Laws at 49 U.S.C. § 5332, Contractor agrees that it will not discriminate against individuals on the basis of disability. In addition, Contractor agrees to comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disability Act," 29 C.F.R. Part 1630, and any implementing requirements FTA may issue.

6.3 **ADA Access Requirements.** In accordance with Section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. §12112 and Section 504 of the Rehabilitation Act of 1973, as amended, 29 U.S.C §794, Contractor agrees that it will comply with the requirements of U.S. Department of Transportation regulations. "Transportation Services for Individuals with Disabilities (ADA)." 49 C.F.R. Part 37; and U.S. Department of Transportation regulations. "Americans with Disabilities (ADA) Accessibility Specifications for Transportation Vehicles," 36 C.F.R. Part 1192 and 49 C.F.R. Part 38, pertaining to facilities and equipment to be used in public transportation. In addition, Contractor agrees to comply with the requirements of 49 U.S.C. §5301(d) which expresses the Federal policy that the elderly and persons with disabilities have the same right as other persons to use mass transportation services and facilities, and that special efforts shall be made in planning and designing those services and facilities to implement transportation accessibility rights for elderly persons and persons with disabilities. These regulations also provide that no individual, solely by reason of a disability shall be excluded from participation in, or be denied the benefit of, or be subjected to discrimination under any program or activity included in or resulting from this Contract. Contractor also agrees to comply with any implementing requirements FTA may issue.

7. CONTRACT TERMINATION, DEBARMENT AND SUSPENSION

7.1 A breach of the contract clauses in 29 C.F.R. 5.5 may be grounds for termination of the Contract and for debarment as a contractor and a subcontractor as provided in 29 C.F.R. 5.12.

7.2 Contractor agrees to provide Metro a copy of each conditioned debarment or suspension certification provided by a prospective subcontractor at any tier, and to refrain from awarding a subcontract with any party that has submitted a conditioned debarment or suspension certification until FTA approval is obtained.

7.3 Contractor shall comply and facilitate compliance with U.S. Department of Transportation (DOT) regulations, "Nonprocurement Suspension and Debarment," 2 C.F.R. Part 1200, which adopts and supplements the U.S. Office of Management and Budget (U.S. OMB) "Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement)," 2 C.F.R. Part 180. The aforementioned provisions of this paragraph apply to each contract at any tier of $25,000 or more, and to each contract to any tier for a federally required audit (irrespective of the contract amount), and to each contract at any tier that must be approved by an FTA official irrespective of the contract amount. As such, Contractor shall verify that its principals, affiliates, and subcontractors are eligible to participate in this FTA federally funded project and are not presently declared by and Federal department or agency to be: (a) debarred from participation in any federally assisted award; (b) suspended from participation in any federally assisted award; (c) proposed for debarment from participation in any federally assisted award; (d) declared ineligible to participate in any federally assisted award; (e) voluntarily excluded from participation in any federally assisted award; or (f) disqualified from participation in any federally assisted award.

7.4 Contractor shall comply with the requirements of 2 C.F.R. Part 180, Subpart C, as supplemented by C.F.R. Part 1200, throughout the term of this Contract.

7.5 Contractor further agrees to comply with and include the requirements of 2 C.F.R. Part 180, Subpart C, as supplemented by C.F.R. Part 1200, in any third-party contracts, subcontracts and lower tier covered transactions it enters into arising from or as a result of this Contract.

8. PROHIBITION ON CERTAIN TELECOMMUNICATIONS, VIDEO SURVEILLANCE OR EQUIPMENT

Contractor is prohibited from obligating or expending grant funds to: (a) Procure or obtain, (b) Extend or renew a contract or procure or obtain; or (c) enter into a contract (to extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system; (d) Contractor shall not provide covered telecommunications equipment or services in the performance of this Contract. As described in Public Law 115-232, section 889, covered telecommunications equipment deemed to pose an unacceptable risk to the national security of the United States or the security and safety of United States persons, Section 1.50002 of the Federal Communication Commission's rules directs the Public Safety and Homeland Security Bureau to publish a list of covered telecommunications equipment and services (Covered List) maintained on the Commissions website: https://www.fcc.gov/supplychain/coveredlist; (e) Telecommunications or video surveillance services provided by such entities or using such equipment; and (f) telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

9. NOTICE OF FTA AND U.S. DOT INSPECTOR GENERAL OF INFORMATION RELATED TO FRAUD, WASTE, ABUSE, OR OTHER LEGAL MATTERS

9.1 If a current or prospective legal matter that may affect the Federal Government emerges, Contractor must promptly notify Metro, which will promptly notify the FTA Chief Counsel and FTA Regional Counsel for Region 7. Contractor must include an equivalent provision in its subcontracts at every tier, for any contract that is a "covered transaction" according to 2 C.F.R. §§ 180.220 and 1200.220.

9.2 The types of legal matters that require notification include, but are not limited to, a major dispute, breach, default, litigation, or naming the Federal Government as a party to litigation or a legal disagreement in any forum for any reason.

9.3 Matters that may affect the Federal Government include, but are not limited to, the Federal Government's interests in the award, the accompanying underlying Agreement between the FTA and Metro, and any Amendments thereto, or the Federal Government's administration or enforcement of federal laws, regulations, and requirements.

9.4 Additional Notice to U.S. DOT Inspector General. Contractor must promptly notify Metro, which will promptly notify the U.S. DOT Inspector General in addition to the FTA Chief Counsel or Regional Counsel for Region 7, if Contractor has knowledge of potential fraud, waste, or abuse occurring on the Project receiving assistance from FTA. The notification provision applies if a person has or may have submitted a false claim under the False Claims Act, 31 U.S.C. §3729, et seq., or has or may have committed a criminal or civil violation of law pertaining to such matters as fraud, conflict of interest, bid rigging, misappropriation or embezzlement, bribery, gratuity, or similar misconduct involving federal assistance. Such notification responsibility occurs whether the Project is subject to this Contract or another contract with Metro involving a principal, officer, employee, agent, or third party of the Contractor. It also applies to subcontractors at any tier. Knowledge, as used in this paragraph, includes, but is not limited to, knowledge of a criminal or civil investigation by a Federal, state, or local law enforcement or other investigative agency, a criminal indictment or civil complaint, or probable cause that could support a criminal indictment, or any other credible information in the possession of the Contractor. In this

paragraph, “promptly” means to refer information without delay and without change. This notification provision applies to all divisions of the Contractor, including divisions tasked with law enforcement or investigatory functions.

10. LOBBYING

Byrd Anti-Lobbying Amendment, 31 U.S.C. 1352, as amended by the Lobbying Disclosure Act of 1995, codified at 2 U.S.C. § 1601, et seq., requires Contractors who apply or bid for an award of $100,000 or more shall file the certification required by 49 CFR part 20, "New Restrictions on Lobbying." Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose the name of any registrant under the Lobbying Disclosure Act of 1995 who has made lobbying contacts on its behalf with non-Federal funds with respect to that Federal contract, grant or award covered by 31 U.S.C. 1352. Such disclosures shall be forwarded from tier to tier up to Metro.

11. NO PROHIBITED INTEREST/CONFLICT OF INTEREST

11. 1 No board member, officer, or employee or agent of Metro or of a local public body who has participated or will participate in the selection, award, or administration of this Contract, nor any member of his or her immediate family, business partner or any organization which employs, or intends to employ any of the above during such period, shall have any interest, direct or indirect, in this Contract or the proceeds thereof, to any share or part of this Contract, or to any benefit arising therefrom. This shall not be construed to prevent any such person from owning stock in a publicly owned corporation.

11.2 No member of, or delegates to, the Congress of the United States shall be admitted to any share or part of the Contract, or to any benefit arising therefrom. This shall not be construed to prevent any such person from owning stock in a publicly-owned corporation.

11.3 Contractor represents to Metro that to the best of Contractor’s knowledge after due and diligent investigation and inquiry, there exists no conflict of interest or other prohibited interest (in either case as contemplated by any Governmental Requirement) that exists or will arise or result from, out of, or in connection with the award of the Contract to Contractor or Contractor’s execution and performance under and in respect of the Contract.

11.4 Contractor also represents that it has no other activities or relationships that would make the Contractor unable, or potentially unable, to render impartial assistance or advice to Metro in respect of Contractor’s performance of the Work or otherwise under or in respect of the Contract or that would impair Contractor's objectivity.

12. TERMINATION

12.1 Termination for Convenience.
Whenever deemed by Metro to be in its best interest, the Contract, and any part thereof, may be terminated by Metro at any time by written notice to Contractor (“Notice of Termination for Convenience”). Such termination will be effective as of the date specified in the Notice of Termination for Convenience. Unless otherwise so specified by Metro in the Notice of Termination for Convenience, Contractor shall immediately stop all Work and shall issue wriitten notice to each Subcontractor to cease

all Work. If Metro elects to terminate the Contract for convenience, then Metro shall be responsible to pay Contractor only for all authorized Work performed up to the date of termination that conforms to the Contract Documents, together with any profit thereupon calculated as set forth in the Contract; provided that there shall not be any allocation of profit for unperformed, remaining or incomplete Work. In no event shall the aggregate charges to be paid by Metro pursuant to the preceding sentence exceed the Contract Sum. In addition, Metro must reimburse Contractor an amount equal to the sum of all out-of-pocket costs and expenses, reasonably and necessarily incurred by Contractor (i) to withdraw its equipment and personnel from the Work and to terminate any subcontract in respect of the Work that is not assumed by Metro as specified in the Notice of Termination for Convenience; provided, however, that Contractor shall not be paid for any Work undertaken by Contractor or by any Subcontractor after Contractor's receipt of Notice of Termination for Convenience or for Work that Contractor could reasonably have avoided Contractor.

12.1.1 Contractor shall promptly submit its claim for payment in the form of an invoice to Metro for the amount of reimbursement claimed by Contractor by application of according to the Contract provisions, together with all supporting information and documentation reasonably demonstrating to Metro that Contractor's claim is allowable, including without limitation, lien waivers from Contractor and all Subcontractors in respect of any Work, whether or not then completed. Contractor must also contemporaneously deliver the assignment of any subcontract that Metro specifies in the Notice of Termination for Convenience. Unless disputed in good faith by Metro, Contractor shall be paid the amount of Contractor's claim within thirty (30) days after receipt of the invoice with the rqeuired assignments and any property in Contractor's possession belonging to Metro.

12.1.2 Contractor shall have no claim, right, remedy or entitlement for damages, compensation or equitable relief for such early termination of the Contract other than as provided in this Section 12.1. Except as expressly provided in this 12.1, contractor hereby irrevocably waives any other rights, remedies and recourse of any nature that it may have against metro, DOT/FTA/the federal government under or in respect of this Contract and the transactions contemplated thereby under any theory of recovery whatsoever under any theory of law whatsoever, whether at law or in equity, including by way of example only, by statute, tort, contract, warranty, indemnity or subrogation.

12.2 Suspension.

Metro may, without cause, order Contractor to suspend, delay or interrupt the Work in whole or in part for such period of time as the owner may determine. The allocated time for performance shall be extended for time caused by the suspension, delay or interruption. The Contract Sum may be adjusted for additional costs to Contractor related directly to the suspension, delay or interruption. Contractor shall have no claim, right, remedy or entitlement for damages, compensation or equitable relief for such suspension except as provided in the preceding sentence; provided, however that loss of unrealized revenue or profit is not is not an allowable cost recoverable due to Contract suspension, delay or interruption. Except as expressly provided in this 12.2, contractor hereby irrevocably waives any other rights, remedies and recourse of any nature that it may have against metro, DOT/FTA/the federal government under or in respect of this contract and the transactions contemplated thereby under any theory of recovery whatsoever under any theory of law whatsoever, whether at law or in equity, including by way of example only, by statute, tort, contract, warranty, indemnity or subrogation.

12.3 Termination for Cause.

Metro shall have the right to terminate this Contract upon the occurrence of any Breach. For purposes of this Section 12.3, a "Default" shall occur whenever Contractor (or any of its Subcontractors) has failed to

comply with or perform, in each instance fully and completely, any covenant, term, condition or other provision of the Contract that is applicable to Contractor. A "Breach" shall occur if there shall occur any of the following events or if there shall occur any Default that Contractor does not cure within any applicable (if any) hereinafter stated grace period:

(a) Any Default, other than a Default specified in Section 12.3 (b)through (d) (in which case the cure period, if any, for such Default shall be that specified in such Section), that remains uncured for ten (10) days after Contractor receives notice from Metro specifying the Default;

(b) Any representation or warranty made by Contractor or any Subcontractor in any Contract Document shall not be, or shall cease to be, not true accurate or complete in any material respect;

(c) There shall occur (whether by operation of law, novation or otherwise) any assignment of the Contract (or any right of Contractor under or in respect of the Contract) without Metro's prior written consent, which consent may be withheld by Metro in its sole judgment and absolute discretion;

(d) There shall occur any of the following events: (i) Contractor shall make any general arrangement or assignment for the benefit of creditors, (ii) Contractor becomes a "debtor" as defined in 11 U.S.C. § 101 or any successor statute thereto (unless, in the case of a petition filed against Contractor, such petition is dismissed within 60 days), (iii) the appointment of a trustee or receiver to take possession of substantially all of Contractor's assets or any of Contractor's interest in the Contractor (or any right of Contractor under or in respect of the Contract), (iv) the attachment, execution, or other judicial seizure of substantially all of Contractor's assets the appointment of a trustee or receiver to take possession of substantially all of Contractor's assets or any of Contractor's interest in the Contract (or any right of Contractor under or in respect of the Contract), where such seizure is not discharged within thirty (30) days; (v) Contractor becomes insolvent within the meaning of Generally Accepted Accounting Principles; (vi) Contractor (or any of its officers, members, shareholders, employees, partners of a felony in connection with the Work; (vii) Contractor attempts to evade any material provision of the Contract or to practice any fraud or deceit upon Metro; (viii) Contractor or any of its Subcontractor's to fully comply with the lawful directives or cooperate with requests of Metro or the Representative; (ix) Contractor fails to provide any insurance or bond within the period provided in the Contract Documents; (x) Contractor fails to pay any sums due to Metro within 5 days of written notice from Metro; (xi) Contractor refuses or fails to timely commence or perform the Work; (xii) Contractor repeatedly refuses or fails to supply enough properly skilled workers or proper materials; (xiii) Contractor fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors; or (xiv) Contractor shall fail, refuse, or neglect to comply with any Governmental Requirement that is not cured within the earlier of (1) the time period that Metro is required by such Governmental Requirement to allow for cure or (2) ten (10) days.

12.3.1 Whether or not sometimes so specified in these General Conditions or in any other Contract Documents, any election by Metro to terminate the Contract or to pursue any other right, remedy or recourse available to Metro under the Contract (whether or not related to any Breach or Default) are cumulative and may be exercised by Metro on one or more occasions; and none of them is to be construed

as excluding Metro from pursing such remedy or any other or any additional right, priority, or remedy allowed or provided by, whether by Law or by any other Governmental Requirement or otherwise, each of which shall survive the expiration or termination of the Contract. In addition, the expiration or termination of the Contract will not relieve Contractor from any obligation or liability under or in respect of the Contract including by application of any indemnity provisions of the Contract or under any bond furnished by Contract pursuant to the Contract, all and each of which also shall survive the expiration or termination of the Contract. Without limitation to the generality of this Section 12.3.1, Contractor acknowledges that if the Contract is terminated for any reason contemplated by Section 12.3, such termination may also result in Contractor being declared to be ineligible for any subsequent contracts with Metro for a period of up to one year or such other/additional time that may be provided in any Governmental Requirement.

12.4 Wrongful Termination by Metro.

In the event Metro may wrongfully terminate the Contract, and if Metro and Contractor do not otherwise agree in writing to re-instate or otherwise continue the Contract in accordance with its terms, Metro's termination shall be construed to be a termination for convenience and the provisions of Section 12.1 shall govern. Except as expressly provided in this Section 12.4, contractor hereby irrevocably waives any other rights, remedies and recourse of any nature that it may have against metro, DOT/FTA/the federal government under or in respect of this contract and the transactions contemplated thereby under any theory of recovery whatsoever under any theory of law whatsoever, whether at law or in equity, including by way of example only, by statute, tort, contract, warranty, indemnity or subrogation.

12.5 Contractor's Right to Terminate.

Contractor shall not be entitled to terminate the Contract for any reason except as provided in this Section 12.5. In the event Metro fails to timely pay to Contractor any undisputed amounts due pursuant to the terms of the Contract, Metro shall be in default under the Contract, but Metro shall be allowed thirty (30) days from receipt of a written notice of such default from Contractor in which to cure such default, after which Contractor may immediately terminate this Contract by written notice to Metro. Any amount disputed by Metro to be due under this Contract must be disputed in good faith. Except as expressly provided in this Section 12.6, contractor hereby irrevocably waives any other right, remedy and recourse of any nature that it may have against metro, DOT/FTA/the federal government under or in respect of the contract and the transactions contemplated thereby for any other default or breach by metro under or in respect of the contract under any theory of recovery whatsoever, whether at law or in equity, including by way of example only, by statute, tort, contract, warranty, indemnity or subrogation.

12.6 Future Default or Breach Not Waived.

One or more waivers by Metro of a Default or Breach by Contractor will not be construed as a waiver of any other Default or Breach or any existing or future waiver of a Default or Breach of the same covenant, term, condition, or provision of this Contract, whether of a similar or different character. The consent or approval by Metro to or of any act by Contractor requiring Metro's consent or approval will not waive or render unnecessary Metro's consent to or approval of any subsequent similar act by Contractor. No waiver or consent by Metro will be binding unless made in writing. Failure of Metro to insist upon strict performance under or in respect of the Contract shall not constitute a waiver of, or estoppel against, Metro requiring strict performance thereafter of the same or any other provision or requirement of the Contract, nor shall a waiver or estoppel in any one instance constitute a waiver or estoppel with respect to a later Default or Breach. Any delay or omission of any party to exercise any right under this Contract shall not impair the exercise of any such right, or any like right, accruing to it thereafter. No waiver of a right

created by this Contract by one or more parties shall constitute a waiver of such right by the other party, except as may otherwise be required by law. The failure of Metro to perform its obligations, including any failure by Metro to pay Contractor as and when required under this Contract shall not release Contractor from the performance of all of its oblgation except as expressly permitted in Section 12.5.

12.7 When Metro terminates the Contract for one of the reasons stated in Section 12.3, Contractor shall not be entitled to receive further payment (whether or not then outstanding, disputed or otherwise) until all Work has been completed.

12.8 Funding Contingency. The Contract is subject to financial assistance provided by DOT and the FTA, Contractor agrees that withdrawal or termination of all or part of any such financial assistance by DOT or the FTA may cause Metro to suspend or terminate the Contract.

13. RESOLUTION OF DISPUTES, BREACHES, OR ARBITRATION

13.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Metro and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

13.1.1 Notice of Claims. Claims by either Metro or Contractor must be initiated by written notice to the other party. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

13.1.2 Continuing Contract Performance Pending Final Resolution of a Claim. Except as otherwise agreed in writing or as expressly provided in these General Conditions, Contractor shall proceed diligently with performance of the Contract and Metro shall continue to make payments in accordance with the Contract Documents.

13.1.3 Claims For Additional Cost. If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under the Contract Section titled Emergencies.

13.1.4 Claims For Additional Time. If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

13.1.5 Claims For Consequential Damages. To the fullest extent permitted by applicable law, in no event shall a party be liable to the other party under or in respect of the contract or as a result of such party’s breach of, or failure to comply with, any covenants, terms, conditions or other provisions of the contract any indirect, incidental, punitive, special or consequential damages, including damages based on loss of profits, revenue, or use, lost profits, lost sales or lost revenues, a multiple of earnings or similar measure of damages incurred by such party, damages to reputation, under, or in respect of, or otherwise arising out of, the contract and any transaction contemplated by thereby or any course of conduct, course of dealing, statements or actions of any of them relating thereto), except to the extent such damages are required to be paid by a party to a third party with respect to a third party claim made against that party. For avoidance of any doubt, no parent, affiliate, or subcontractor and none of its r their respective officers,

directors, shareholders, contractors, subcontractors, partners, members, shareholders joint venture participant or similar persons shall be construed to be a third party within the meaning of the exception herein provided. Each party hereby irrevocably waives any rights, remedies and recourse that it may have to recover or be allowed to recover such damages under any theory of law whatsoever, whether at law or in equity, including by way of example only, by statute, tort, contract, warranty, indemnity or subrogation.

13.2 INITIAL DECISION – DISPUTE RESOLUTION

13.2.1 Claims, excluding those arising under Contract Sections titled Hazardous Materials and shall be referred to the Owner unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 13.2.1, an initial decision shall be required as a condition precedent to litigation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

13.2.2 The Initial Decision Maker will review Claims and take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

13.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

13.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

13.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to litigation.

13.2.6 If a Claim has not been resolved after consideration of the foregoing, and of further evidence presented by the parties, the dispute shall be decided by the Initial Decision Maker, who shall reduce this decision to writing and furnish a copy thereof to the Contractor. The decision shall be final and conclusive unless within ten (10) days from the date of receipt of such copy, the Contractor furnishes a written appeal addressed to the Executive Director of Metro, with copy to the Procurement Manager, for the determination of such appeals which shall be final and conclusive unless subsequently determined by a court of competent jurisdiction to have been fraudulent or capricious, or arbitrary, or so grossly

erroneous as necessarily to imply bad faith, or not supported by any evidence. In connection with any appeal proceeding under this clause, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its appeal. Pending final decision of a dispute and thereafter irrespective of the result or any appeal, Contractor shall proceed diligently with the performance of the Contract and in accordance with the Director of Procurement's decision. This clause does not preclude consideration of questions of law in connection with decisions provided for above; provided that nothing in this Contract shall be construed as making final the decision of any administrative official or board on a question of law. On procurement items in which the FTA funding is involved, the Contractor shall be aware of protest procedures with the FTA Regional Office.

13.2.7 In the event of a Claim against Contractor, Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

13.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

13.3 Arbitration. The Commercial Arbitration Rules of the AAA and any amendments to shall govern any arbitration proceeding hereunder. The arbitration shall be conducted by a commercially experienced arbitrator selected pursuant to the Commercial Arbitration Rules, and pre-hearing discovery shall be permitted if and only to the extent determined by the arbitrator to be necessary in order to effectuate resolution of the matter in dispute. The construction, interpretation and performance hereof and all transactions hereunder shall be governed by the laws of the State of Nebraska, without giving effect to the principles of conflict of laws thereof. Equitable remedies shall be available from the arbitrator. Consequential, punitive, exemplary, indirect or similar damages shall not be awarded by the arbitrator, although attorneys' fees and the costs of arbitration may be assessed against either or both Parties. The arbitrators' judgment shall be final and binding on the Parties. Any award and judgment may be entered and enforced in any court of competent jurisdiction.

14. BUY AMERICA

Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 C.F.R. Part 661, which provide that Federal funds may not be obligated unless all steel, iron, and manufactured products used in FTA funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 C.F.R. § 661.7. The Buy America Certification duly executed by a designated representative of Contractor is hereby incorporated by reference in this Contract.

15. CLEAN AIR

15.1 Contractor shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 – 7601(q) et seq . During the performance of the Contract, Contractor: (a) Shall not use any violating facilities; (b) Shall report the use of facilities place on or likely to be placed on the U.S. Environmental Protection Agency's (EPA) "List of Violating Facilities;" (c) Shall report each violation to Metro and understands and agrees that Metro, in turn, shall report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

15.2 Contractor also agrees to include the Clean Air Act requirements as provided in paragraph 15.1 in each subcontract exceeding $100,000 financed in whole or in part with FTA assistance.

16. CLEAN WATER

16.1 Contractor shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Water Act, as amended, 33 U.S.C. §1251 et seq. During the performance of the Contract, Contractor: (a) Agrees to report each violation to Metro and understands and agrees that Metro will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office in compliance with the notice of violating facility provisions in section 508 of the Clean Water Act, as amended, 33 U.S.C. 1368; and (b) Agrees to protect underground sources of drinking water in compliance with the Safe Drinking Water Act of 1974, as amended, 42 U.S.C. 300f – 300j-6.

16.2 Contractor also agrees to include the Clean Water Act requirements in each subcontract exceeding $100,000 financed in whole or in part with FTA assistance.

17. ENERGY CONSERVATION

Contractor agrees to comply with mandatory standards and policies relating to energy efficiency, which are contained in the State of Nebraska Energy Codes issued in compliance with the Energy Conservation and Production Act of 1976 (ECPA), as amended, and any State of Nebraska energy conservation plans issued in compliance with the Energy Policy and Conservation Act of 1975 (EPCA).

18. E-VERIFY

Contractor must use the U.S. Department of Homeland Security's (DHS) E-Verify System to verify the employment eligibility of all new employees hired during the term of this Contract. The Contractor must also include a requirement in subcontracts that the subcontractor must utilize the E-Verify system to verify the employment eligibility of all new employees hired by the subcontractor during the term of this Contract. If the Contractor is not enrolled in DHS E-Verify System, it shall do so within five (5) calendar days of notice of contract award. The link to E-Verify is e-verify.gov. Upon each Contractor or subcontractor new hire, the Contractor must provide a statement within five (5) calendar days to Metro identifying the new hire with its E-Verify case number.

19. EMPLOYEE PROTECTIONS

Certain employee protections apply to all FTA-funded contracts with particular emphasis on construction related projects. Contractor shall comply with all federal laws, regulations, and requirements, including:

19.1 Davis-Bacon and Copeland Anti-Kickback Acts.

19.1.1 Minimum Wages. All laborers and mechanics employed or working upon the site of the Work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached

hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be always posted by the contractor and its subcontractors at the site of the Work in a prominent and accessible place where it can be easily seen by the workers.

19.2.1 The Contracting Officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination, and which is to be employed under the Contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met: (1) Except with respect to helpers as defined as 29 CFR 5.2(n)(4), the Work to be performed by the classification requested is not performed by a classification in the wage determination; and (2) the classification is utilized in the area by the construction industry; and (3) the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and (4)with respect to helpers as defined in 29 CFR 5.2(n)(4), such a classification prevails in the area in which the work is performed.

19.2.2 If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within thirty (30) days of receipt and so advise the Contractor or will notify the Contractor within the thirty (30) day period that additional time is necessary.

19.2.3 In the event the Contractor, the laborers, or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

19.2.4 The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 19.3.1 or 19.4.1 of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

19.3.1 Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

19.4.1 If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

19.5.1 The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination, and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met: (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and (2) The classification is utilized in the area by the construction industry; and (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

19.5.2 If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within thirty (30) days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the thirty (30) day period that additional time is necessary.

19.5.3 In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination with thirty (30) days of receipt and shall advise the Contracting Officer or will notify the Contracting Officer within the thirty (30) day period that additional time is necessary.

19.5.4 The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 19.5.2 or 19.5.3 of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

19.2 Contract Work Hours and Safety Standards Act.

Contractor shall comply with all federal laws, regulations, and requirements providing wage and hour protections for non-construction employees, in accordance with 40 U.S.C. § 3702, Contract Work Hours and Safety Standards Act, and other relevant parts of the Act, 40 U.S.C.§ 3701 et seq., and DOL regulations, “Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted

Construction (also Labor Standards Provisions Applicable to Non-construction Contracts Subject to the Contract Work Hours and Safety Standards Act)," 29 C.F.R. Part 5. No contractor or subcontractor contracting for any part of the Contract Work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

19.2.1 Any records maintained under this section shall be made available by the Contractor for inspection, copying, or transcription by authorized representatives of the FTA and the Department of Labor, and the Contractor will permit such representatives to interview employees during working hours on the job.

19.3 Prevailing Wage & Anti-Kickback.

Contractor and subcontractors shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR Part 3), which are incorporated into this Contract by this reference. In addition, the Weekly Statement of Compliance required by these regulations shall also contain a statement that the fringe benefits paid are equal to or greater than those set forth in the minimum wage decision. The FTA requires that all construction or repair contracts include provisions that the Contractor comply with the Copeland Anti-Kickback Act which prohibits Contractor from inducing any person employed on the project to give up any portion of their pay. Further, the provision requires Metro to report all suspected or reported violations to FTA.

20. SAFE OPERATION OF VEHICLES

20.1. Seat Belt Use. Contractor understands and acknowledges that it is encouraged to implement Executive Order No. 13043, "Increasing Seat Belt Use in the United States," April 16, 1997, 23 U.S.C. § 402 note, (62 Fed. Reg. 19217), by: (i) adopting and promoting on-the-job seat belt use policies and programs for our employees and other personnel that operate company-owned vehicles, company-rented vehicles, or personally operated vehicles; and (ii) including a "Seat Belt Use" provision in each third party agreement related to this Agreement.

20.2 Distracted Driving, Including Text Messaging While Driving. In accordance with Executive Order No. 13513, "Federal Leadership on Reducing Text Messaging While Driving," October 1, 2009, 23 U.S.C. § 402 note, (74 Fed. Reg. 51225); U.S. DOT Order 3902.10, "Text Messaging While Driving," December 30, 2009; and U.S. DOT Special Provision pertaining to Distracted Driving, Contractor understands and acknowledges that it is encouraged to: (i) adopt and enforce workplace safety policies to decrease crashes caused by distracted drivers, including policies to ban text messaging while using an electronic device supplied by us, and driving a vehicle the driver owns or rents, a vehicle the we own, lease, or rent, or a privately-owned vehicle when on official business in connection with this Contract or when performing any work for or on behalf of Metro under this Contract; (ii) conduct workplace safety initiatives in a manner commensurate with its size, such as establishing new rules and programs to prohibit text messaging while driving, re-evaluating the existing programs to prohibit text messaging while driving, and providing education, awareness, and other outreach to employees about the safety risks associated with texting while driving. Contractor agrees to include the preceding "Distracted Driving, Including Text Messaging While Driving" provision in all third-party or subcontractor contracts related to this Contract.

21. BONDING FOR CONSTRUCTION ACTIVITIES EXCEEDING $250,000

Bonds are required for all construction or facility improvement contracts and subcontracts exceeding the simplified acquisition threshold. The minimum requirements for a performance bond and payment bond are set forth in Section 2.2 (B-E) of this Division of the bid documents.

22. SEISMIC SAFETY

Contractor agrees that any new building or addition to an existing building will be designed and constructed in accordance with the standards for Seismic Safety required in Department of Transportation (DOT) Seismic Safety Regulations 49 C.F.R. Part 41 and will certify to compliance to the extent required by the regulation. The contractor also agrees to ensure that all work performed under this contract, including work performed by a subcontractor, follows the standards required by the Seismic Safety regulations and the certification of compliance issued on the Project.

23. VETERAN PREFERRANCE

Contractor shall give a hiring preference, to the extent practicable, to veterans (as defined in U.S.C. Section 2108 of title 5) who have the requisite skills and abilities to perform the Work required under the Contract. This requirement shall not be understood, construed or enforced in any manner that would require an employer to give a preference to any veteran over any equally qualified applicant who is a member of any racial or ethnic minority, female, an individual with a disability, or a former employee.

24. PROCUREMENT OF RECOVERED MATERIALS

A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR Part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines. In the performance of this Contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired: (a) Competitively within a timeframe providing for compliance with the Contract performance schedule; (b) Meeting Contract performance requirements; or (c) At a reasonable price. Information about this requirement, along with the list of EPA-designate items, is available at EPA's Comprehensive Procurement Guidelines web site, https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program.

25. DISADVANTAGED BUSINESS ENTERPRISE (DBEs)

25.1 This Contract is subject to the requirements of 49 CFR Part 26. METRO's overall goal for DBE participation is available on its website. METRO has not set a separate DBE contract goal for this FTA federally assisted contract. As this Contract exceeds $100,000 and does not have a DBE contract goal, Metro encourages the Contractor to provide subcontracting opportunities of a size that small business concerns, including DBEs, could reasonably perform, rather than self-performing all the work. This

includes, where appropriate, breaking out contract work items into economically feasible units to facilitate small business enterprise (SBE)/DBE participation, even when the Contractor might have the ability and otherwise prefer to perform these work items with its own forces.

25.1.1 Metro encourages Contractors on U.S. DOT-assisted contracts to investigate to the full extent of services offered by financial institutions owned and controlled by socially and economically disadvantaged individuals in the community and to make reasonable efforts to use these institutions.

25.2. The Contractor, Sub-recipient or Subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this U.S. DOT-assisted contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of U.S. DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as Metro deems appropriate, which may include, but is not limited to:

(1) Withholding monthly progress payments.
(2) Assessing sanctions.
(3) Liquidate damage; and/or
(4) Disqualifying the contractor from future bidding as non-responsible.

25.3 Soliciting DBE Participation

All Bidders should make every reasonable effort to subcontract work to DBEs through Good Faith negotiations and solicitations in advance of the dates specified in this invitation for submitting and opening of bids.

Only those DBEs who are currently certified through the Nebraska Department of Transportation (NDOT) Civil Rights Office or DBEs having certification that can be made final through the NDOT Civil Rights Office in accordance with applicable provisions of 49 CFR Part 26 before the due date for this invitation on which a firm seeks to participate as a DBE can be counted towards Metro's overall DBE goal. For a listing of Nebraska certified DBEs, see: http://dot.nebraska.gov/business-center/civil-rights.

25.4 Prompt Payment and Retainage

25.4.1 The Contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than thirty (30) days from the receipt of each payment the Contractor receives from Metro. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of Metro. This clause applies to both DBE and non-DBE subcontractors.

Metro may require the Contractor to provide documentation to verify payments to all subcontractors have been received by the subcontractors within 30 days after Metro has issued payment.

25.4.2 The Contractor agrees to return retainage payments to each subcontractor within thirty (30) days after the Subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of Metro. The Contractor shall incorporate a contract clause obligating the Contractor to pay all retainage owed to the Subcontractor for

satisfactory completion of the accepted Work within 30 days after Metro's payment to the Contractor.

Metro requires the Contractor to submit documentation to verify incorporation of the retainage clause into the respective contracts as well as documentation that retainage payments to all Subcontractors have been returned to the Subcontractors within 30 days after the Subcontractor's work has been satisfactorily completed and accepted by the Contractor and/or Metro. Metro may also hold retainage from the Contractor and provide for prompt and regular incremental acceptances of portions of the prime contract and/or pay retainage to the Contractor based on these acceptances.

25.4.3 The Contractor shall maintain records and documents of payments to DBEs for three (3) years following the performance of the Contract. These records will be made available for inspection upon request by any authorized representative of Metro or the United States Department of Transportation. This reporting requirement also extends to any certified DBE subcontractor.

25.4.4 Complaints by subcontractors regarding the prompt payment requirements are handled according to the following procedure.

- If the affected subcontractor is not comfortable contacting the Contractor directly regarding payment or is unable to resolve payment discrepancies with the Contractor, the subcontractor should contact the Disadvantaged Business Enterprise Liaison Officer (DBELO) to initiate a complaint.
- Metro's Disadvantaged Business Enterprise Liaison Officer (DBELO) will facilitate meeting(s) between the Contractor and affected subcontractor, with additional Metro staff attending, as appropriate.
- If filing a prompt payment complaint with the DBELO does not result in timely and meaningful action by Metro to resolve a prompt payment dispute, the affected subcontractor may as the next step regarding a resolution, contact the Federal Transportation Administration (FTA).

25.4.5 Metro may enact any of the following penalties if the Contractor fails to comply with prompt payment requirements:

- No further progress payments will be made until Metro is able to verify that subcontractors were paid within 30 days after the most recent payment made to the Contractor.
- Pay subcontractors directly and deduct this amount from the retainage owed to the Contractor.
- Other penalties for failure to comply, up to and including contract termination, and disqualifying the Contractor from future Metro project bidding as non-responsible for a period of up to three (3) years.

25.5 Good Faith Efforts.

During the term of this Contract, the Contractor shall continue to make good faith efforts to ensure that DBE subcontractors have the maximum opportunity to successfully perform under this Contract. Such efforts shall include, without limitation, the following:

25.5.1 Substitution. If a DBE firm is selected to perform Work and fails to complete its work for any reason, the Contractor shall make written request to Metro for substitution of the original DBE firm set forth in its bid. Upon receipt of METRO's written consent for substitution of the original DBE firm, the Contractor shall exert good faith efforts to replace the DBE firm with another certified DBE Subcontractor.

25.5.2 Termination. Contractor shall not terminate for convenience any DBE firm set forth in its Project bid documents, and then perform the DBE's Work itself or with its affiliates without prior written consent of Metro.

25.6 Any and all contracts the Contractor executes with third-party contractor(s) or subcontractor(s) in the performance of this Contract must comply with the requirements of 49 C.F.R. 26.13(b) and must include the prompt payment assurance in any and all contracts with such third-party contractor or subcontractor. The Contractor may be required to provide Metro with copies of all third-party contracts or subcontracts as well as records of payments to all subcontractors for compliance monitoring.

26. CARGO PREFERENCE (If Shipper via ocean going vessel)

The contractor agrees to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying contract to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels.

To furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of -lading in English for each shipment of cargo described in the preceding paragraph to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the contractor in the case of a subcontractor's bill-of-lading.)

To include these requirements in all subcontracts issued pursuant to this contract when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

27. FLY AMERICA REQUIREMENTS

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and sub-recipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

28. TRAFFICKING IN PERSONS

The contractor agrees that it and its employees that participate in the Recipient's Award, may not:

(a) Engage in sever forms of trafficking in persons during the period of time that the Recipient's Award is in effect;

(b) Procure a commercial sex act during the period of time that the Receipient's Award is in effect; or

(c) Use forced labor in the performance of the Recipient's Award or subagreements thereunder.

28. FEDERAL TAX LIABILITY AND RECENT FELONY CONVICTIONS

The contractor certifies that it:

(a) Does not have unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; and

(b) Was not convicted of the felony criminal violation under any Federal law withing the proceeding 24 months.

DIVISION 2-
REQUIRED SUBMISSION DOCUMENTS

REQUIRED SUBMISSION DOCUMENTS

The Regional Metropolitan Transit Authority of Omaha
PROJECT NAME: BOILERS REPLACEMENT
PROJECT No.: NE-90-X144
SPECIFICATION: 04-26

The following forms are **REQUIRED** to be submitted with the bid proposal and can be found on the pages following.

_____Proposal Form and BID Form

_____Exhibit “A” to the General Conditions, Receipt of Federal Clauses for Construction

_____Exhibit “B” to the General Conditions, Debarment/Suspension - Prime

_____Exhibit “C” to the General Conditions, Debarment/Suspension - Sub

_____Exhibit “D” to the General Conditions, Affidavit of Non-Collusion – Prime

_____Exhibit "E” to the General Conditions, Affidavit of Non-Collusion - Sub

_____Exhibit “F” to the General Conditions, Lobbying Certification

Exhibit “G” Request for Clarification or Substitution/Approved Equals *(do not to be included in the required submission documents)*

_____Exhibit “H” Acknowledgement of Addendum

_____Exhibit “I” Conflict of Interrest Disclosure

_____Exhibit “J” Buy America Acknowledgement

_____Exhibit “K” Davis Bacon Wage Acknowledgement

_____Exhibit “L” DBE Participation Form

_____Exhibit “M” DBE Confirmation Form

_____Exhibit “N” Subcontractor Utilization Form

_____ Exhibit “O” Federal Tax Liability & Recent Felony Convictions

_____ Exhibit “P” Bidder’s List Data Form

Additionally, bidders must submit a bid bond in the amount of 5% of their bid amount along with their bid proposal and required forms.

Please ensure all forms are signed and dated and all requested infromation is assigned.

PROPOSAL FORM

To: The Regional Metropolitan Transit Authority of Omaha, (Metro)
2222 Cuming Street
Omaha, Nebraska 68102

The undersigned, having carefully examined the Drawings, Specifications, and all Addenda thereto and other IFB Documents prepared by SRF Consulting Group, Inc. for the construction of the Metro Transit Boilers Replacement, NE-90-X144, at 2222 Cuming Street, Omaha, NE 68102 and having carefully examined the site of work and become familiar with all local conditions including labor affecting the cost thereof, and having familiarized himself with Federal, State and local laws, ordinances, rules and regulations affecting performance of the work, do hereby propose to furnish all labor, mechanics, superintendence, tools, material, equipment, and all utilities and transportation services necessary to perform and complete said work and work incidental thereto, in a workmanlike manner, as described in said Drawings, Specifications, and other IFB Documents including Addenda No(s). _____ issued thereto, for_____.

For purposes of complete this Proposal Form please see (*Bid Tabulation Table*) following this Proposal Form in which itemize each part of the Total Bid.

PROJECT	TOTAL BID
BOILERS REPLACEMENT PROJECT TOTAL BID	$

The total bid for bid items 1-31 is:
$_____dollars and _____cents.

The undersigned further certifies that he/she has personally inspected the actual location of the work, together with the local sources of supply and that he/she understands the conditions under which the work is to be performed, or that if he/she has not so inspected the site and conditions of the work, he/she waives all right to plead any misunderstanding regarding the work required or conditions peculiar to the same.

The undersigned understands the conditions of the project as stipulated in the Bid Form herein attached.

BID –

The installation of new boilers directly impacts Metro's ability to provide heat to the building. In order to ensure that Metro is ready to turn on the heat when the weather turns, the boilers (B-1 and B-2) must be installed and providing heat to the building no later than October 15, 2026. The project must be substantially complete by November 30th, 2026.

Retained percentage on all pay estimates will be 10% until all work is completed and accepted by Metro.

This project is sales tax exempt. Bidders shall not include sales tax in their bid. Metro will issue the successful bidder with a sales Tax Exemption certificate and Purchasing Agent Appointment for materials used on this project.

The work includes the cost of materials, labor, bonds & insurance necessary to accommodate the work.

The undersigned hereby agrees, if awarded the Contract to furnish a Performance Bond in an amount equal to One Hundred percent (100%) of the Contract Sum as security for the faithful performance of the Contract (including warranty and guarantee provisions) and also a Labor and Material Payment Bond in an amount not less than One Hundred percent (100%) of the Contract Sum as security for the payment of all persons performing labor on the project under the Contract and furnishing materials in connection with this Contract and a Maintenance Bond in an amount not less than One Hundred percent (100%) of the Contract Sum as security for warranty from defects in materials and workmanship on the project.

The undersigned also agrees to furnish the required Bonds and Insurance Certificates and to execute the Contract within fifteen (15) days from and after the Notice of Award and further agrees to begin and complete all work under Contract within the time limits set forth in the IFB document.

Accompanying this Proposal, as a guaranty that the undersigned will execute the Contract and furnish satisfactory Bonds and Insurance Certificates in accordance with the terms and requirements of the Contract Documents, is a bid security of the type specified in the IFB Documents made payable to The Regional Metropolitan Transit Authority of Omaha, Omaha, Nebraska, in an amount of **5%** of the amount Base Bid.

Metro has not set a separate DBE contract goal for this FTA federally assisted contract. Metro will encourage the prime contractor to provide subcontracting opportunities.

If the undersigned assures that they will include DBE participation they will include the DBE clauses required by the Sponsor's DBE Program in all subcontracts that offer subcontracting opportunities. The undersigned will complete and submit (with the bid) the attached DBE Participation Forms the bidder shall submit a DBE Confirmation Form signed by each DBE subcontractor.

The DBE participation will be counted in accordance with 49 CFR 26.55.

The undersigned understands that the schedule of minimum wage rates, as established by the US Department of Labor and included in Division 4 of this manual, govern on this project. The undersigned certifies that they have examined this schedule of wage rates and that the prices bid are based on such established wage rates.

The undersigned certifies that they do not maintain or provide for their employees any segregated facilities at any of their establishments, and that they do not permit their employees to perform their services on any location under their control where segregated facilities are maintained. The undersigned certifies further that they will not maintain or provide for their employees any segregated facilities at any of their establishments, and that they will not permit their employees to perform their services at any location, under their control, where segregated facilities are maintained. The undersigned agrees that a breach of this certification is a violation of the equal opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or any other reason. The undersigned agrees that (except where they have obtained identical certifications from proposed small Subcontractors for specific time periods) they will obtain identical certifications from proposed Subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause, and that they will retain such certifications in their files.

The undersigned states that they are complying with and will continue to comply with fair labor standards, as defined in Nebraska State Statues, in the pursuit of their business and in the execution of the contract pursuant to this bid.

The undersigned hereby declares that the only parties interested in this proposal are named herein, that this proposal is made without collusion with any other person, firm, or corporation, that no member of the council, officer or agent of the sponsor, is directly or indirectly financially interested in this bid.

It is hereby agreed that in case of failure of the undersigned either to execute the Contract or to furnish Bonds or Insurance Certificates which are satisfactory to Metro Transit within thirty (30) days after issuance of Notice to Award, the amount of this proposal guaranty shall be forfeited to the Regional Metropolitan Transit Authority of Omaha d/b/a Metro, Omaha, Nebraska as liquidated damages arising out of the failure of the undersigned either to execute the Contract or to furnish Bonds or Insurance Certificates as proposed. It is understood that in case the undersigned is not awarded the work, the bid guaranty will be returned as provided in the IFB Documents.

If awarded the Contract, our Surety will be _____
(name of Surety Company)
of _____.

The undersigned Contractor is complying with and will continue to comply with Fair Labor Standards as defined in Nebraska State Statutes, in pursuit of all business including execution of the Contract on which we are bidding herein.

In the event of a discrepancy between unit prices quoted in this Proposal and the extensions or totals, the unit prices shall control.

Respectfully submitted,
Signature of Proposer: _____

a) If and Individual: _____
(Signature of Individual)
Doing Business as: _____
(Name of firm)

b) If a Partnership: _____
(Name of Partnership)_
_____
(Signature of Partner)
_____
(Signature of Partner)

c) If a Corporation: _____
(Name of Corporation)

ATTEST:
Officer's Signature:_____
Title:_____
Business Address: _____
Phone No._____ Fax No. _____

BID FORM

TOTAL PROJECT (BOILER REMOVAL, BOILER/HEATER REPLACEMENT, ETC.)

Item #	Description	QTY	UNIT	UNIT PRICE	Total Cost
1	MOBILIZATION	1	LS		
WITHIN BOILER ROOM					
2	EXISTING BOILERS/EQUIPMENT DEMOLITION/ REMOVAL				
3	B-1 CONDENSING BOILER MATERIAL				
4	B-1 CONDENSING BOILER LABOR				
5	B-2 CONDENSING BOILER MATERIAL				
6	B-2 CONDENSING BOILER LABOR				
7	B-4 DUAL-FUEL BOILER MATERIAL				
8	B-4 DUAL-FUEL BOILER LABOR				
9	P-5, P-6, P-7 PUMP MATERIAL				
10	P-5, P-6, P-7 PUMP MATERIAL				
11	FAN COIL UNIT (FCU) MATERIAL				
12	FAN COIL UNIT (FCU) LABOR				
13	GLYCOL TANK AND PUMP (GST-1 AND GP-1) MATERIAL				
14	GLYCOL TANK AND PUMP (GST-1 AND GP-1) LABOR				
15	FAN COIL UNIT (FCU-6) MATERIAL				
16	FAN COIL UNIT (FCU-6) LABOR				
17	UNIT HEATER (UH) MATERIAL				
18	UNIT HEATER (UH) LABOR				
19	TRANSFER FAN (TF-1) MATERIAL				
20	TRANSFER FAN (TF-1) LABOR				
21	MISCELLANEOUS MATERIAL				
22	MISCELLANEOUS LABOR				
OUTSIDE BOILER ROOM ELEMENTS					
23	EXISTING HEATER/MISCELLANEOUS REMOVAL				
24	BASEBOARD HEATERS (BH), FIN TUBE (FT) AND CONVECTORS (CH) MATERIAL				
25	BASEBOARD HEATERS (BH), FIN TUBE (FT) AND CONVECTORS (CH) LABOR				
26	FAN COIL UNIT (FCU) MATERIAL				
27	FAN COIL UNIT (FCU) LABOR				
28	UNIT HEATER (UH) MATERIAL				
29	UNIT HEATER (UH) LABOR				
30	MISCELLANEOUS MATERIAL				
31	MISCELLANEOUS LABOR				
	TOTAL BID (Items 1-31)				

"CERTIFICATE"

A Corporate Contractor, in submitting this Proposal hereby represents that the Corporation has complied with all Nebraska Statutory requirements, which are prerequisite to its being qualified to do business in the State of Nebraska, or that it will take all steps necessary to qualify, if the successful bidder.

_____By_____

(Name of Corporation) (Officer) (Title)

If Foreign Corporation: _____

Nebraska Resident Agent

SYNOPSIS OF EXPERIENCE RECORD

(This synopsis must accompany Proposal Form)

Name of Bidder: _____

Business Address: _____

Check one: Individual ( ) Partnership ( ) Corporation ( )

Construction successfully completed within the past five years similar in size, scope, and difficulty of construction to the work bid upon.

	Name of Owner	Name of Project	Location of Project	Amount of Contract
1.				
2.				
3.				
4.				

	Number of Contract Days Allowed for Above Projects	Actual Number of Days to Complete Above Project
1.		
2.		
3.		
4.		

Signed: _____

(Name of Company)

By: _____

Title: _____

Date: _____

END OF PROPOSAL FORM

EXHIBIT A

RECEIPT OF FEDERAL CLAUSES

Project: **BOILERS REPLACEMENT**

Date:

Project No. **NE-90-X144**

Specification No. **04-26**

I have reviewed the attached Federal Clauses for Procurement of Construction in conjunction with Metro's procurement of **Project No. NE-90-X144, Specification No. 04-26 BOILERS REPLACEMENT** for which:

_____

_____

has provided qualifications for consideration and hereby affirm that:

_____

_____

shall conform to and abide by all aforementioned requirements as set forth and any amendments thereto.

_____
Authorized Representative

_____
Title

_____ _____
Company Name DUNS/TINS Number

_____
Date

EXHIBIT B

DEBARMENT AND SUSPENSION CERTIFICATION FOR PROSPECTIVE CONTRACTOR

Project: **BOILERS REPLACEMENT** **Date:**

Project No. **NE-90-X144** **Specification No.** **04-26**

Primary covered transactions must be completed by Bidder for contract value over $25,000.

Choose one alternative:

□ The Bidder,_____ certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;

2. Have not within a three-year period preceding this Bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or Contract under a public transaction; violation of federal or state antitrust statutes or commission or embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in Paragraph 2 of this certification; and

4. Have not within a three-year period preceding this Bid had one or more public transactions (federal, state or local) terminated for cause or default. OR

□ The Bidder is unable to certify to all of the statements in this certification, and attaches its explanation to this certification. (In explanation, certify to those statements that can be certified to and explain those that cannot.) The Bidder certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of Title 31 USC § Sections 3801 are applicable thereto

Executed in:

_____
Name

_____
Authorized Signature

_____
Title

_____
Date

_____
DUNS/TIN Number

EXHIBIT C

DEBARMENT AND SUSPENSION CERTIFICATION (LOWER-TIER COVERED TRANSACTION)

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

This form is to be submitted by each Subcontractor receiving an amount exceeding $25,000.

- The prospective lower-tier participant (Bidder) certifies, by submission of this Proposal, that neither it nor its "principals" as defined at 49 CFR § 29.105(p) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

If the prospective Bidder is unable to certify to the statement above, it shall attach an explanation, and indicate that it has done so by placing an "X" in the following space: _____

THE Bidder, _____ CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF _____,

EACH STATEMENT OF ITS CERTIFICATION AND EXPLANATION, IF ANY. IN ADDITION, THE BIDDER UNDERSTANDS AND AGREES THAT THE PROVISIONS OF 31 USC §§ 3801 *ET SEQ.* APPLY TO THIS CERTIFICATION AND EXPLANATION, IF ANY.

Name and title of the Bidder's authorized official:

Name	Title
Authorized Signature	Date
DUNS/TIN Number:	

EXHIBIT D
NON-COLLUSION AFFIDAVIT PRIME

This affidavit is to be filled out and executed by the Bidder; if a corporation makes the proposal, then by its properly executed agent. The name of the individual swearing to the affidavit should appear on the line marked "Name of Affiant." The affiant's capacity, when a partner or officer of a corporation, should be inserted on the line marked "Capacity." The representative of the Bidder should sign his or her individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach his or her seal.

The form does not modify, replace, amend or supersede any provisions of the IFB Documents or the Contract Documents.

– State of _____ , County of _____

I, _____, being first duly sworn, do hereby state that

(Name of Affiant)

I am _____ of _____

(Capacity) (Name of Firm, Partnership or Corporation)

whose business is and who resides at _____

and that _____

(Give names of all persons, firms, or corporations interested in the bid)

is/are the only person(s) with me in the profits of the herein contained Contract; that the Contract is made without any connection or interest in the profits thereof with any persons making any bid or Proposal for said Work; that the said Contract is on my part, in all respects, fair and without collusion or fraud, and also that no members of the Board of Directors, head of any department or bureau, or employee therein, or any employee of the Authority, is directly or indirectly interested therein.

Sworn to before me this_____ day of _____, 20____.	– S e a l -
Notary Public My Commission Expires	

EXHIBIT E
NON-COLLUSION AFFIDAVIT (LOWER-TIER)

This affidavit is to be filled out and executed by the Bidder; if a corporation makes the proposal, then by its properly executed agent. The name of the individual swearing to the affidavit should appear on the line marked "Name of Affiant." The affiant's capacity, when a partner or officer of a corporation, should be inserted on the line marked "Capacity." The representative of the Bidder should sign his or her individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach his or her seal.

The form does not modify, replace, amend or supersede any provisions of the IFB Documents or the Contract Documents.

– State of _____ , County of _____

I, _____, being first duly sworn, do hereby state that

(Name of Affiant)

I am _____ of _____

(Capacity) (Name of Firm, Partnership or Corporation)

whose business is and who resides at _____

and that _____

(Give names of all persons, firms, or corporations interested in the bid)

is/are the only person(s) with me in the profits of the herein contained Contract; that the Contract is made without any connection or interest in the profits thereof with any persons making any bid or Proposal for said Work; that the said Contract is on my part, in all respects, fair and without collusion or fraud, and also that no members of the Board of Directors, head of any department or bureau, or employee therein, or any employee of the Authority, is directly or indirectly interested therein.

Sworn to before me this_____ day of _____, 20____.	– S e a l -
Notary Public My Commission Expires	

EXHIBIT F

LOBBYING CERTIFICATE

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

The Bidder certifies, to the best its knowledge and belief, that:

1. No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of a federal department or agency, a member of the U.S. Congress, an officer or employee of the U.S. Congress, or an employee of a member of the U.S. Congress in connection with the awarding of any federal Contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification thereof.

2. If any funds other than federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal Contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instruction, as amended by "Government-wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96).

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants and contracts under grants, loans and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, USC § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

THE BIDDER, _____ , CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF EACH STATEMENT OF ITS CERTIFICATION AND DISCLOSURE, IF ANY. IN ADDITION, THE BIDDER UNDERSTANDS AND AGREES THAT THE PROVISIONS OF 31 USC §§ 3801 ET SEQ. APPLY TO THIS CERTIFICATION AND DISCLOSURE, IF ANY.

_____

Name of the Bidder or Bidder's Authorized Official

_____

Title

_____ _____

Signature *Date*

EXHIBIT G

REQUEST FOR SUBSTITUTIONS/APPROVED EQUALS

Project: **BOILERS REPLACEMENT** **Date:**

Project No. **NE-90-X144** **Specification No.** **04-26**

Use one form per requested equal/per clarification; duplicate as needed.

SPECIFIED ITEM: _____

Section: _____

Drawing Number(s): _____ Detail Number(s): _____

PROPOSED SUBSTITUTION: _____

_____

REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS: _____

_____

(1) Attach product data that includes description, specifications, drawings, photographs, performance and test data adequate for evaluation of request; applicable portions of data are clearly identified.

(2) Attached data also includes a description of changes to Contract Documents that proposed substitution will require for its proper installation.

(3) The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. Proposed Substitution has been fully checked and coordinated with Contract Documents.
2. Proposed Substitution does not affect dimensions shown on Drawings.
3. Proposed Substitution does not require revisions to mechanical or electrical work.
4. The undersigned will pay for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by requested Substitution.
5. Proposed Substitution will have no adverse affect on other trades, construction schedule, or specified warranty requirements.
6. Maintenance and service parts will be locally available for proposed substitution.

(4) The undersigned further states that the function, appearance, and quality of proposed Substitution are equivalent or superior to specified item.

Submitted by:

_____ By: _____

(Firm) (Signature)

_____ Telephone: (_____)_____

(Address)

For use by the Architect/Engineer:

[ ] Approved [ ] Approved as noted [ ] Not Approved [ ] Received too late

_____

Signature Title Date

Remarks:

_____

_____

EXHIBIT H

ACKNOWLEDGMENT OF ADDENDA

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

If, in the course of this request for bidders, it becomes necessary to modify the original solicitation documents, acknowledged receipt of each addendum must be clearly established and included with the bidder. Failure to acknowledge receipt of all addenda may cause a Bidder to be considered non-responsive.

Acknowledgment of Addenda

The undersigned acknowledges receipt of the following addenda to the original solicitation documents:

Addendum No. _____, Dated _____

Addendum No. _____, Dated _____

Addendum No. _____, Dated _____

Addendum No. _____, Dated _____

Addendum No. _____, Dated _____

Addendum No. _____, Dated _____

_____

Company

_____

Street Address, City, State, Zip

_____

Signature of Authorized Representative

_____

Title of Authorized Representative

_____

Phone

EXHIBIT I

CONFLICT OF INTEREST DISCLOSURE STATEMENT

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

As the Contractor's project manager or approved representative, I, _____ hereby certify that: I am familiar with the attached conflict of interest guidance and the conflict-of-interest laws including, but not limited to, 49 CFR 18.36, 48 Fed Reg. 34263, 40 CFR 1506 and Nebraska Rev. Stat. §§49-1401 to 1444 and 49-1493 to 14,104.

And to the best of my knowledge and belief, of all relevant facts – concerning past present or currently planned interests or activities (financial, contractual, organizational or otherwise that relate to the proposed work and bear on whether I have or my organization has a possible conflict of interest), determined that, for myself, any Owner, partner or employee with my firm or any of my sub-consulting firms providing services for this project, including any family members and personal interests, that for the above referenced project:

☐ No real or potential conflicts of interest exist with respect to (1) be able to render impartial, technically sound, and objective assistance or advice and (2) being given an unfair competitive advantage.

☐ Real conflicts of interest or the potential for conflicts of interest exist.

Furthermore, I certify that I have reviewed the proposed scope of work and project area and to the best of my knowledge, determined that, for myself, any Owner, partner or employee, with my firm or any of my sub-consulting firms providing services for this project, including family members and personal interests of the above persons that are no financial or other interests in the outcome of the project, including but not limited to work associated with the Boilers Replacement unless described and noted on the attached.

If a real or potential conflict has been identified, describe on the attached sheet the nature of the conflict, including the information requested on the reverse side of this form for the type of conflict being reported, and provide a detailed description of Contractor's proposed mitigation measures (if possible). Complete and sign this form and send it, along with all attachments, to Metro.

Furthermore, I certify that for myself, any Owner, partner, or employee with my firm or any of my sub-consulting firms providing services for this project, will comply with professional codes of conduct governing participation in the above referenced project and whenever conducting business on behalf of Metro.

I recognize that a conflict-of-interest disclosure is an ongoing obligation. Should I or my organization become aware of any actual or potential conflicts of interest during the performance of this contract, I or my organization will advise Metro and propose mitigation or explain why none is needed. Conflicts of interest or the failure to disclose conflicts, real or potential, may preclude award of a contract or termination of a contract for cause.

Signature:_____

Printed Name:_____ Organization:_____

Title:_____ Date:_____

EXHIBIT I- (cont.)

CONFLICT OF INTEREST DISCLOSURE STATEMENT

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

REAL OR POTENTIAL CONFLICT DESCRIPTION:

EXHIBIT I- (cont.)

CONFLICT OF INTEREST DISCLOSURE FORM

The following Sections are provided as guidance in determining whether a real or potential Conflict of Interest (COI) exists and in disclosing details concerning potential conflicts of interest.

Section 1 – Contractor Officer or Employee COI

Is there anyone in your firm or business who is either; (1) employed by, on a full or part time basis; or (2) a public official or agent of, the local public agency or partner agencies from whom this Invitation for Bid (IFB) has been received?

If yes, please list below: (1) the name, address and phone number of the person(s); (2) the position held by that person(s) with Contractor; (3) the position held by that person(s); and (4) a detailed description of the duties of that person(s) for the local public agency, including whether that person(s) has any duties concerning the negotiating, approving, accepting or administering of any contract or subcontract for the federal-aid transportation project?

Section 2 – Persons Associated with local public agency, Financial or Personal Interest Conflict of Interest

The potential for conflicts of interest extends to persons associated with a local public agency official, employee or agent. There may be a conflict of interest on a federal-aid project if a person associated with an official, employee or agent has a financial or personal interest in a consulting firm or business providing services for a project. These indirect conflicts of interest can extend to the following persons associated with an LPA official, employee, or agent: (a) Any member of his [or her] immediate family; (b) his [or her] partner; or (c) an organization which employs, or is about to employ, any of the above, when that organization has a financial or other interest in the firm selected for award. Is there anyone with a financial or personal interest in your firm or business who is associated with (as listed in the preceding sentence) and responsible for negotiating, approving, accepting or administering any contract or subcontract on behalf of Metro for this project?

If yes, please below: (1) the name, address and phone number of the person(s); (2) the nature of the financial or personal interest in firm; (3) the person's relationship to Metro, including the position held by the official, employee or agent of Metro; and (4) a detailed description of the duties of the official, employee or agent of Metro, including whether that person(s) has any duties for the Metro concerning the negotiating, approving, accepting or administering of any contract or subcontract for Metro's federal-aid transportation project?

EXHIBIT I- (cont.)

CONFLICT OF INTEREST DISCLOSURE FORM

Section 3 – Real Estate COI

If Contractor (or sub-Contractor) has an interest in real estate located along or near the project **that might be acquired, in whole or in part,** for this federal-aid transportation project, which interest is either; (1) through anyone in Contractor's organization, including a member of immediate family or a sub-Contractor, having an ownership interest in; or (2) through a client for whom Contractor has been retained to provide professional services to the owner for that tract of land, then Contractor must disclose such interest and abstain from being involved in any aspect of the right-of-way valuation or acquisition process for the federal-aid transportation project.

If either of these situations exist, please provide below: (1) the name of the Owner, the address and legal description of the property, and a description of the Contractor's interest in the property; (2) a map or aerial photo identifying the location of the property; (3) a description of the potential need or use of this property for the federal-aid transportation project; and (4) a declaration by Contractor that it will comply with the third sentence of 23 CFR Section 1.33.

Section 4 – Outcome of Project bias/Objectivity

If Contractor, agent or subcontractor because of other activities, financial interests, relationships, or contracts is unable, or potentially unable, to render impartial assistance or advice to the grantee (including the appearance of inability), then the Contractor must disclose such interest.

If any of these situations exist, please list below the nature of any potential partiality or appearance of any potential bias when Contractor, agent or subcontractor has or at any time during the life of the contract, any pecuniary or other interests in the outcomes of the project not listed above.

Section 5 – Unfair Competitive Advantage

Unfair competitive advantage occurs when one contractor has information not available to other contractors in the normal course of business. For example, an unfair competitive advantage would occur when a contractor developing specifications or work statements has access to information that the grantee has paid the contractor to develop, or information which the grantee has furnished to the contractor for its work, when that information has

EXHIBIT I- (cont.)
CONFLICT OF INTEREST DISCLOSURE FORM

not been made available to the public. Another example where an unfair competitive advantage might arise is where a contractor is allowed to write specifications or statements of work around its own or an affiliate's corporate strengths or products and then compete for a contract based on those specifications. If an individual employee has access to inside information, a possible solution would be to wall off that employee, so he cannot give his employer an unfair competitive advantage.

If any of these conditions exist, describe below (1) the nature of the unfair competitive advantage including the type of information involved, (2) its source, and (3) the dates when such information was obtained or generated.

_____

_____

_____

_____

Section 6 – Supplemental

Do you (or your organization or subcontractor(s)) have or have you ever had any contracts, agreements, special clauses or other arrangements which prohibit you from proposing work to be performed in this solicitation or any portion thereof:

_____

_____

_____

_____

To avoid what you perceive as a possible conflict of interest do you or your organization or subcontractors propose to exclude portions of the proposed work; employ special clauses; or take other measures?

_____

_____

_____

Other relevant information pertaining to a conflict of interest or potential for a conflict of interest:

_____

_____

EXHIBIT I- (cont.)
CONFLICT OF INTEREST DISCLOSURE

Section 7 – Mitigation Plan

If applicable, please describe any proposed mitigation measures or plan:

_____

_____

_____

_____

_____

Signature: _____

Printed Name: _____

Organization: _____

Title: _____

Date: _____

EXHIBIT J

BUY AMERICA ACKNOWLEDGEMENT

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

The Bidder agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7, and Separate requirements for rolling stock are set out at 5323(j)(2)(C) and 49 CFR 661.3.

The Bidder must submit to Metro the appropriate Buy America certification below with its Bid. Bid that are not accompanied by a completed Buy America certification will be rejected as nonresponsive**. In accordance with 49 C.F.R. § 661.6, for the procurement of steel, iron or manufactured products, use the certifications below.**

Certificate of Compliance with Buy America Requirements

The Proposer hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(1), and the applicable regulations in 49 C.F.R. part 661.5.

Date: _____

Signature: _____

Company:_____

Name: _____

Title:_____

Certificate of Non-Compliance with Buy America Requirements

The Proposer hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j)(1) and 49 CFR 661.5, but it may qualify for an exception to the requirement pursuant to 49 U.S.C. 5323(j)(2) as amended, and the applicable regulations in 49 C.F.R. § 661.7.

Signature: Date:_____

Name:_____

Company:_____

Title:_____

This form must be signed and submitted in bid package. All signatures must be original.

EXHIBIT K
DAVIS BACON WAGE ACKNOWLEDGEMENT

Project:	**BOILERS REPLACEMENT**	**Date:**	
Project No.	**NE-90-X144**	**Specification No.**	**04-26**

I have reviewed the attached Davis-Bacon Preliminary Wage Determination in conjunction with Metro Transit's procurement of **BOILERS REPLACEMENT** for which _____ has provided pricing and hereby affirm that _____ shall conform to and abide by the aforementioned requirements and as set by the Davis-Bacon Act and any amendments thereto.

See Division 4 for schedule of Davis Bacon Wages by Profession.

_____
Authorized Representative

_____
Title

_____
Company Name

_____
Date

EXHIBIT L

DBE PARTICIPATION FORM

All Bidders are required to complete and submit this form with their bid **if DBE participation is applicable.**

The undersigned Bidder has satisfied the requirements of the IFB Documents in the following manner (please check the appropriate space):

_____The Bidder is committed to DBE participation on this contract.
_____The Bidder is not committed to DBE participation on this contract.

Name of Letting Agency: Regional Metropolitan Transit Authority of Omaha	Name of Project: **BOILERS REPLACEMENT**
METRO Project #: NE 90-X144	METRO Specification #: 04-26

	Name of Certified DBE	Description of Work or Line Item Number	$ Amount to be Paid DBE	Amount to be Credited Toward Goal
1				
2				
3				
4				
5				

NOTE: Overhead costs are not eligible for DBE credit. Show only the amount that will actually be paid to the DBE. Only 60% of the amount paid to a DBE supplier, for materials, may be credited toward the goal.

_____
Print Name of Firm

_____
Print Name of Authorized Representative Print Email Address

_____
Print Title of Authorized Representative

_____
Area Code & Telephone Number Area Code & Fax Number

_____
Signature of Authorized Representative

(**NOTE**: *If additional sheets are needed, attach to this sheet. However, show the contract total on this sheet.*

EXHIBIT M
DBE CONFIRMATION FORM

All Bidders are required to have DBEs complete this form and submit it with their proposal **if DBE participation is applicable.**

Base Bid	
Name of Letting Agency: Regional Metropolitan Transit Authority of Omaha	Name of Project: **BOILERS REPLACEMENT**
METRO Project: NE-90-X144	METRO Specification No.: 04-26

Item Number or Description of Work to be Completed by This DBE:
Dollar Amount to be Completed by This DBE:

~~Print Name of Firm~~ _____

Print Name of Authorized Representative _____ Print Email Address _____

Print Title of Authorized Representative _____

Print Street Address/Mailing Address *(including City, State & Zip)* _____

Area Code & Telephone Number _____ Area Code & Fax Number _____

Signature of Authorized Representative _____

EXHIBIT N

SUBCONTRACTOR UTILIZATION FORM

All Bidders are required to complete and submit this form with their bid.

All bidders are required to submit this form with their bid showing the identity of DBEs and non-DBEs from whom quotes were requested in response to this IFB. If no quotes were received, Bidder must indicate this in the space provided.

Name of Letting Agency: Regional Metropolitan Transit Authority of Omaha		Name of Project: BOILERS REPLACEMENT		
METRO Project #: NE-90-X144		METRO Specification No: 04-26		
Name of Firm from whom a quote was requested		**Description of Work or Line-Item Number**	**Quote Received**	
			Yes	**No**
1				
2				
3				
4				
5				
6				
7				

Print Name of Firm

Print Name of Authorized Representative Print Email Address

Print Title of Authorized Representative

Print Street Address *(including City, State and Zip)*

Area Code & Telephone Number Area Code & Fax Number

Signature of Authorized Representative

EXHIBIT O
FEDERAL TAX LIABILITY & RECENT FELONY CONVICTIONS CERTIFICATION

Project: BOILERS REPLACEMENT **Date _____**

Project No. NE-90-X144 **Specification No. 04-26**

The undersigned Offeror certifies, to the best of his or her knowledge and belief, that:

1. It has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; and
2. It has not been convicted of a felony criminal violation under any federal law within the preceding 24 months.

The Offeror certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification. In addition, the Proposer understands and agrees that the provisions of 31 USC §§ 3801 et al. are applicable to this certification.

Date: _____

Signature: _____

Company: _____

Name: _____

Title: _____

EXHIBIT P

BIDDERS LIST FORM

Regional Metropolitan Transit Authority of Omaha
dba METRO

BIDDERS LIST DATA FORM

METRO is required pursuant to 49 CFR Part 26(c) to create and maintain a comprehensive Bidders List. The information provided on this Bidders List Data Form will be used to determine the relative availability of Disadvantaged Business Enterprises (DBEs) and non-DBEs and will assist with establishing Metro's annual DBE goal. Metro's Bidders List is a compilation of bidders, proposers, quoters, subcontractors, and suppliers of materials and services who have submitted bids during the advertising period of a solicitation for services and/or goods. **Please provide the following information:**

1. Business Name: _____

2. Business Address: _____
   **Address must include ZIP code* _____

3. Contact Person: _____

   Title: _____

4. Phone: _____

5. Fax: _____

6. Email Address: _____

7. Age of Business: _____
   Years, Months

8. SAM #: _____

9. Business Annual Gross Receipts

   Annual gross receipts, as defined in 13 CFR 121.104, equals "total income" plus "cost of goods sold".

   ___Less than $1 million
   ___$1-3 million
   ___$3-6 million
   ___$6-10 million
   ___More than $10 million

10. Do the affiliated annual gross receipts, averaged over the previous three fiscal years, exceed $30.72 million for this business? ___Yes ___No

11. Is this business a small business, as defined by the U.S. Small Business Administration? ___Yes ___No

12. Will the business subcontract any work, service, and/or materials? ___Yes* ___No

    **If yes, all subcontractor(s) must complete their own Bidders List Data Form.*

Regional Metropolitan Transit Authority of Omaha
dba METRO

BIDDERS LIST DATA FORM

13. Is this business a certified DBE under Nebraska's Department of Transportation (NDOT) Unified Certification Program (UCP)? _____Yes _____No

14. Provide all NAICS codes applicable to each scope of work you seek to perform in this bid: _____

15. For certified DBEs under the NDOT UCP, is/are the NAICS code(s) above the NAICS code(s) under which you are certified as a DBE? _____ Yes _____ No

16. What ethnicity is the majority owner of the business?
More than one ethnicity may be selected.

_____ Black American
_____ Asian-Pacific American
_____ Native American
_____ Hispanic American
_____ Subcontinent-Asian American
_____ Non-Minority

17. Is the majority owner of the business a woman? _____Yes _____No

The undersigned hereby declares that the information set forth on this form is current, complete and accurate.

Authorized Signature: _____

Printed Name: _____

Title: _____

Date: _____

Submit the completed form(s) with your bid, proposal, or quote.

DIVISION 3 -
SUPPLEMENTAL CONDITIONS

SUPPLEMENTARY CONDITIONS

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ARTICLE	TITLE
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3.	LIQUIDATED DAMAGES
4.	DEFINITIONS AND MATERIALS REFERENCES
5.	CONSTRUCTION SCHEDULE
6.	PRE-CONSTRUCTION CONFERENCE
7.	HAUL ROADS, ACCESS POINTS, AND STORAGE
8.	COSTS OF TESTING
9.	PERMITS AND COMPLIANCE WITH LAWS
10.	STORMWATER AND GRADING PERMITS
11.	FINAL PAYMENT
12.	CLEAN UP AND DISPOSAL
13.	GUARANTEE
14.	INSURANCE
15.	SALES TAX
16.	CONSTRUCTION REFERENCE STAKING
17.	MEASUREMENTS AND PAYMENTS
18.	OPERATIONAL SAFETY DURING CONSTRUCTION
19.	SHOP DRAWING SUBMITTALS
20.	CERTIFICATES AND TESTING

SUPPLEMENTARY CONDITIONS
(Special Conditions)

1. START DATE.

The Project work shall be commenced within FIFTEEN (15) days after the issuance of **the Notice to Proceed**. Anticipated start date is **May 4, 2026**. Notice to Proceed will be given once METRO TRANSIT's Representative consults with the CONTRACTOR and verifies that they are in compliance with these specifications for submittals of shop drawings, schedule, safety plan, etc.

2. CONTRACT TIME AND PHASING.

The installation of new boilers directly impacts Metro Transit's ability to provide heat to the building. In order to ensure that Metro is ready to turn on the heat when the weather turns, the boilers (B-1 and B-2) must be installed and providing heat to the building no later than October 15, 2026. The project must be substantially completed by November 30th, 2026.

3. DEFINITIONS AND MATERIALS REFERENCES.

All references to "inspection" and "inspector" shall be replaced with "observation" and "observer" respectively. The phrases "Special Provisions" and "Special Conditions" are interchangeable and are considered to be the same document. Reference in these IFB Documents to any material or method of construction by propriety name, make, or catalog number is done to establish a standard of quality and not to limit competition. The Contractor may, at their option, use any other material, system, or method of construction, which, in the judgment of Metro's Representative, is equal to that name. Request must be made in writing and to receive consideration for substitution, full information must be furnished to ensure that no redesign of the project will be necessary.

4. CONSTRUCTION SCHEDULE.

Prior to the preconstruction conference, the Contractor shall submit to Metro's Representative for approval a complete work schedule, including a list of Subcontractors and the work that they will perform. As a minimum, the schedule shall provide information on the sequence of work activities, milestone dates, and activity duration.

The schedule shall reflect the requirement for the boilers B-1 and B-2 to be installed and providing heat by **October 15, 2026.** The Contractor will be required to accomplish the work items according to the schedule of construction as submitted to Metro's Representative.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule every two weeks, or as otherwise requested by Metro's Representative. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

5. PRECONSTRUCTION CONFERENCE.

After the Notice to Proceed has been issued and prior to commencement of any work Metro Transit's Representative will meet with the Contractor, and the Subcontractors (as appropriate) to discuss the work in general. Discussion will include administrative matters, accident prevention, safety precautions, answer any questions of Metro Transit's Representative or Contractor, and to resolve any potential problems before the work commences.

6. HAUL ROUTES, ACCESS POINTS, AND STORAGE:

The Contractor shall access the project only via the access points and haul routes authorized by Metro Transit's Representative. Equipment may be parked and material stored only in locations approved by Metro's Representative. The exact location of haul routes, parking and storage areas shall be determined by Metro Transit's Representative prior to the start of construction.

The haul routes shall be utilized for all equipment traffic, and the equipment shall not be allowed to stray or wander away from the established routes. The haul roads shall be the responsibility of the Contractor and shall be maintained and kept in good order at all times. The Contractor shall repair any damage caused by the movement of equipment on any of the haul roads, whether in designated or undesignated areas.

All areas used for haul routes, access, storage and parking shall be restored to their original condition by the Contractor, including seeding, at no expense to Metro Transit.

The performance of any work as specified by this provision, including watering, maintenance, and repair of the haul roads, shall not be measured and paid for directly, but shall be considered as necessary and incidental to the work.

7. COSTS OF TESTING.

In general, acceptance testing (as defined in the Specifications and exclusive of any retesting) will be paid for by Metro Transit through the bid price. Any retesting necessitated by noncompliance with the specification requirements may result in an amount, equal to the cost of retesting, being deducted and retained, from subsequent estimates due the Contractor, at the discretion of Metro's Representative. In general, quality control testing will be the responsibility of the Contractor. See each specific specification in Division 7 for identification of the Contractor's testing responsibilities.

8. PERMITS AND COMPLICANCE WITH LAWS.

The Contractor shall procure and pay for all permits, licenses and bonds necessary for the prosecution of their work, and/or required by Local, State and Federal regulations and laws, as pertains particularly to permits and transportation of materials and equipment, or other operations which are not specific requirements of these specifications. The Contractor shall give all notices, pay all fees, and comply with all Federal, State, and Local laws, ordinances, rules, and regulations, and building and construction codes bearing on the conduct of the work.

9. STORM WATER AND GRADING PERMITS.

NOT APPLICABLE

10. FINAL PAYMENT.

On satisfactory completion of all items as called for in the contract and in accordance with the approved plans and specifications, the Contractor shall furnish to Metro Transit a written clearance from the Nebraska Department of Labor, certifying that all payments then due for contributions or interest on wages paid to individuals employed in the performance of this contract have been made by the Contractor or his Subcontractor to the Unemployment Compensation Fund. Upon receipt of the above clearance, the Contractor will be eligible to receive final payment for the contract, less previous progress payments.

Minor errors or omissions in the plans, proposal or specifications, shall not relieve the Contractor from the fulfillment of the general intent of the contract to satisfactorily complete any item or items called for in the plans, specifications and proposal form.

11. CLEAN UP AND DISPOSAL.

All waste and removed material produced as a result of the Contractor's operations and not reused in the project shall be cleaned up and disposed of off the property by the Contractor at no expense to Metro.

12. GUARANTEE.

All Work shall be performed in a good and workman like manner using highest industry standards and in accordance with good construction practices and pursuant to, subject to, and in conformity with the Contract Documents. Contractor warrants that (a) all materials, supplies and equipment furnished in respect of Work will be new and of good quality unless otherwise expressly permitted by the Contract Documents, (b) all Work will be free from defects not inherent in the quality required or permitted and will otherwise conform to the Contract Documents, as evidenced by Contractor to the satisfaction of Metro Transit whenever requested by Metro Transit, and (c) Contractor shall repair, replace, correct or otherwise remediate any deficient, defective or non-conforming Work for a period of two years from Metro Transit's acceptance of all Work, or such longer period as may be applicable by application of provision of any of the other Contract Documents. During the warranty period, Contractor shall repair, replace, correct or otherwise remediate any deficient, defective or non-conforming Work at its own expense. All corrected Work shall carry an additional one-year warranty period, beginning on the date on which the Metro Transit accepts the corrected Work.

Acceptance of any portion of the Work prior to final acceptance shall not release Contractor from liability for faulty workmanship or materials or for failure to fully comply with all of the terms of the Contract. Metro Transit reserves the right and shall be at liberty to inspect all Work any time and shall have the right to reject all materials and workmanship which do not conform with the Contract Documents; provided, however, that Metro Transit is under no duty to make such inspection, and no inspection so made shall relieve Contractor from any obligation to furnish any Work as required by the Contract Documents.

13. INSURANCE.

As a condition to the Contract, the successful Proposer will be required to procure policies of insurance and deliver certificates thereof to Metro Transit, in each case meeting all requirements of, and as and when required by, the IFB Documents.

14. SALES TAX.

Metro Transit is exempt from payment of federal excise and transportation tax and any sales and use taxes otherwise applicable under the Laws. No such taxes shall be included in the Contract Amount or any unit or other price required to be identified in the Bid Proposal. By submission of its Bid, Bidder acknowledges that it has taken into consideration and made allowances for all of the ordinary delays and hindrances incident to the Work, whether because of delays in procuring equipment, materials, workers or other causes and that Bidder must undertake and complete the Project and the Work as and when required by the IFB Documents. Metro Transit will furnish the Contractor a "Purchaser Agent Appointment" Form 17 for use in purchasing materials.

15. CONSTRUCTION REFERENCE STAKING.

NOT APPLICABLE

16. MEASUREMENTS AND PAYMENTS.

Specifications that provide for separate direct payment for items except those listed in the proposal are void.

Items that are to be removed and not reused in the work or not designated to be furnished to Metro Transit are to become the property of the Contractor unless otherwise specified. Any salvage value the items may have shall be reflected in the unit prices.

Items that do not have a specific specification section but are rather detailed on the drawings require a method of measurement and basis of payment are the following:

METRO TRANSIT ADMINISTRATION/GARAGE BUILDING BOILERS REPLACEMENT PROJECT

Item 1 – Mobilization- Mobilization shall be measured as a lump sum and paid for at the contract unit price. Mobilization will include bond costs, insurance costs, sanitary facilities, and other incidentals for the complete construction of the project.

Item 2-22 (list based on Bid Form line items) – Remove and Replace dual-fuel boilers, system pumps, associated mechanical and plumbing equipment, fan units and heating units - The following will be completed within the area containing the existing boilers:

- Remove existing boilers and associated pumps, branch piping shown in Plan Set.
- Remove and replace air intake ductwork and equipment shown in Plan Set.
- Disconnect existing hot water supply system from existing Glycol system. Glycol feed system is to remain.
- Provide and install two (2) condensing boilers and associated mechanical and plumbing equipment as shown in the Plan Set.
- Provide and install one (1) dual-fuel boiler and associated mechanical and plumbing equipment as shown in the Plan Set.
- Provide and install three (3) heating water pumps and associated equipment.
- Provide and install supplemental Glycol tank and connect feed system.

Item 23-31 (list based on Bid Form line items) – Remove and Replace Piping, Heaters and associated equipment - The following will be completed outside the area containing the existing boilers:

- Remove existing floor and wall mounted heaters in Level 1 and Lower-Level as shown in the Demolition Plan.
- Remove existing piping in Level 1 and Lower-level as shown in the Plan Set.
- Provide and install thirty (30) unit heaters and associated equipment in Level 1 and the Lower-Level as shown in the Plan Set.
- Provide and install thirty (30) wall mounted and baseboard/fin tube/convector heaters and associated equipment and insulation as shown in the Plan Set.
- Provide and install thermostats and connect with building management system as shown in the Plan Set.

17. OPERATIONAL SAFETY DURING CONSTRUCTION.

The Contractor shall submit a Safety Plan for each sequence of work for approval by Metro Transit and Metro Transit's Representative to assure compliance with the safety provisions.

The Contractor's plan should include, but not be limited to, a plan sheet(s) showing work area limits, access points, haul routes, equipment and material storage area(s), employee parking area(s), barricades, and sign locations.

The Contractor shall be responsible for all signing, barricades, and safety requirements as set forth by these specifications. The Contractor is responsible for its own safety and any review of its safety plan by Metro Transit's Representative does not change this responsibility.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks of the safety plan measures to assure compliance with the safety plan measures.

The Contractor is responsible to Metro Transit for the conduct of all Subcontractors it employs on the project. The Contractor shall assure that all Subcontractors are made aware of the requirements of the safety plan and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved safety plan unless approved in writing by Metro Transit or Metro Transit's Representative.

18. SHOP DRAWING SUBMITTALS.

The Contractor shall submit shop drawings for the following items prior to installation/construction of each item:

22 1005 – Natural gas piping and valves
23 0519 – Meters and gauges
23 0523 – Valves
23 0553 – Identification
23 0593 – TAB Report
23 0713 – Duct insulation
23 0719 – Piping insulation

23 0913.13 – Control devices
23 0934 – Variable-Frequency Controllers
23 0993 – Sequence of Operations
23 1113 – Fuel oil piping and accessories
23 2113 – Hydronic piping
23 2114 – Hydronic specialties
23 3700 – Air Outlets and Inlets
23 5100 – Boiler vent
23 5216 – Boilers
23 8200 – Fan coil units, baseboard heaters, convector heaters, fin tube, electric duct heaters
26 2726 - Wiring Devices
26 2813 – Fuses
26 2816.16 – Enclosed Switches
26 2913 – Enclosed Controllers

19. CERTIFICATES AND TESTING.

The Contractor shall submit certificates and test results for the following items:

Certificates-

1. As per requirements of technical specifications

Testing-

1. As per requirements of technical specifications

END OF DIVISION 3 – SUPPLEMENTAL CONDITIONS

DIVISION 4-
WAGE RATES (Davis-Bacon)

"General Decision Number: NE20260057 01/02/2026

Superseded General Decision Number: NE20250057

State: Nebraska

Construction Type: Building
BUILDING CONSTRUCTION INCLUDING WORK ON INDUSTRIAL SITES

County: Douglas County in Nebraska.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Modification Number Publication Date
0 01/02/2026

BRNE0001-001 06/01/2025

	Rates	Fringes
BRICKLAYER	$ 34.80	19.94

CARP0427-001 06/01/2025

	Rates	Fringes
CARPENTER (Including Acoustical Ceiling		

Installation).....$ 33.42 18.66

CARP0427-004 06/01/2025

	Rates	Fringes
CARPENTER (Drywall Hanging, Finishing/Taping Only).....	$ 33.42	18.66

ELEC0022-001 06/01/2025

	Rates	Fringes
ELECTRICIAN.....	$ 46.40	20.89

ELEV0028-001 01/01/2025

	Rates	Fringes
ELEVATOR MECHANIC.....	$ 55.88	38.435+a+b

FOOTNOTE:

a. Vacation Pay: 8% for persons with 5 or more years of service, 6% for persons with less than 5 years of service.

b. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0571-004 10/01/2024

	Rates	Fringes
OPERATOR: Crane.....	$ 36.44	18.69
OPERATOR: Forklift.....	$ 31.06	18.69

IRON0021-002 06/01/2025

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	$ 39.00	22.30

LABO1140-003 10/01/2023

	Rates	Fringes
LABORER (Mason Tender, Brick & Hod).....	$ 24.00	13.48

PLUM0016-003 05/25/2025

	Rates	Fringes
PLUMBER (Excluding HVAC Pipe Installation).....	$ 44.26	16.90

PLUM0464-006 06/01/2025

	Rates	Fringes

PIPEFITTER (Includes HVAC
Pipe Installation and
Excludes HVAC System
Installation).....$ 46.25 21.10

SFNE0669-001 04/01/2025

Rates Fringes

SPRINKLER FITTER (Fire
Sprinklers).....$ 43.79 28.35

SHEE0003-001 07/01/2023

Rates Fringes

SHEET METAL WORKER (Including
HVAC Duct & System
Installation).....$ 39.65 19.87

SUNE2011-031 10/27/2011

Rates Fringes

CAULKER.....$ 17.13 0.00

CEMENT MASON/CONCRETE FINISHER...$ 18.44 4.08

ELECTRICIAN (Low Voltage
Wiring).....$ 21.54 5.99

FORM WORKER.....$ 19.07 3.84

GLAZIER.....$ 17.67 1.71

LABORER: Common or General.....$ 15.47 5.34

OPERATOR:
Backhoe/Excavator/Trackhoe.....$ 22.55 5.72

OPERATOR: Bobcat/Skid
Steer/Skid Loader.....$ 23.11 0.91

OPERATOR: Loader.....$ 20.76 4.64

PAINTER: Brush, Roller and
Spray.....$ 14.26 0.00

ROOFER.....$ 13.57 0.77

TRUCK DRIVER, Includes Dump
and Tandem Truck.....$ 14.77 1.41

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave

for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, the contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025. The applicable Executive Order minimum wage rate will be adjusted annually. Additional

information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council

number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union

rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which

the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as

conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative

Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION

"

DIVISION 5-
SAMPLE FORMS

REQUEST FOR CLARIFICATION

Project Name: Boilers Replacement
Date: _____

Company Name: _____ Page No: _____

Document Reference (check one):

General Requirements: ____

Specifications: ___ __

Section Number:_____
Section Title:_____

Construction Drawings: _____

Sheet Number and Name: _____

BIDDER'S REQUEST:

METRO RESPONSE:

Approved _____ Denied _____

Metro Comments:

_____ _____
Metro Authorized Signature Date of Response
Procurement and Contracts Manager
Metro Transit, 2222 Cuming Street, Omaha, NE 68102
Email: ldelriolopez@omentro.com

Performance Bond

KNOW ALL MEN BY THESE PRESENTS: That_____as Principal, and_____, as Surety, are held and firmly bound onto the Transit Authority of the City of Omaha d/b/a Metro, hereinafter referred to as Metro, and _____ hereinafter referred to as _____. jointly and severally, in the penal sum of _____for payment of which well and truly to be made we do hereby jointly and severally bind ourselves, our heirs, executors, administrators, personal representative, successors and assigns.

WHEREAS, the aforesaid Principal is about to *enter, or has entered into a contract with
Metro whereby said Principal agrees to *construct:

Boilers Replacement Project NE-90-X144, Spec No. 04-26, hereinafter referred to as “construction work”:

The conditions of the above obligation are such that, whereas the above named Principal desires permission from Metro to perform the above stated construction work.

NOW, THEREFORE, INCONSIDERATION of being permitted by Metro to perform said construction work, said Principal does hereby agree as follows:

1. To well and faithfully perform all of Principal’s obligations regarding and pertaining to said construction work.

2. To comply with the Plans and Specifications pertaining to said construction work and Metro of any other’s concerned with or affected by the performance and execution of said construction work and to comply with and faithfully observe and obey all applicable Rules and Regulations of Metro now existing relating to the performance of said construction work and any work done pertaining thereto.

3. At all times during the progress of the work, the Principal shall have at said construction a representative authorized to take orders and act in the Principal’s place.

4. During the period guaranty, to promptly attend to repairs and maintenance.

5. To observe all laws and City Ordinances relating to obstructing streets, maintaining signals, keeping open passageways, protecting the same where exposed, and pertaining to those engaged in the performance of such construction work.

6. To fully protect, indemnify, and save harmless Metro and their employees, and their successors from all expenses, costs, claims, demands, suits, judgments, exactions, executions, and liabilities of every name and description for or on account of any injuries or damages received or sustained by an party or parties in any way connected with, relating to , or growing out of the aforesaid construction work and any work pertaining thereto, or on account of any acts, negligence, or failure of the Principal hereunder or any of Principal’s servants, agents, or subcontractors or other acting for Principal or under Principal’s direction or in said construction work or any work pertaining thereto, or on account of any claims of damage for infringement of any patent in fulfilling the obligations of the Principal.

7. To furnish all material and work in a conformity with the specifications and in a workmanlike manner to the satisfaction of Metro and Metro’s Representative the same shall have the right: to inspect all materials and work, and to take samples of materials for testing purposes.

8. To place all materials for said construction work on the streets and in the ground in such manner as not to impede traffic.

9. To remove all remnants and waste upon completion of the construction work.

10. To perform, without expense to the obliges, any appurtenant work not specified in the aforesaid contract which may be fairly implied as included therein which Metro, shall judge to be fairly implied as included in said construction work.

11. Upon being so directed by Metro or Metro's Representative, to remove or to reconstruct, or to make good at the Principal's own cost, any work which Metro or Metro's Representative, or shall decide defective. Any omission to condemn any work at the time of its construction shall not be construed as an acceptance of any defective work by Metro or Metro's Representative and Principal shall correct any imperfect work whenever discovered within the guarantee period.

12. To protect control stakes and to be held responsible for any defective work occasioned by failure or negligence to do so.

13. To maintain in continuous good condition, satisfactory to Metro any and all work constructed by Principal under the aforesaid construction for a period of (2) TWO YEARS from and after the aforesaid acceptance by Metro.

14. To pay or cause to be paid as and when due all contributions and interest to the Unemployment Compensation Fund of the State of Nebraska from Principal or an Contractor or Sub-Contractor because of or in any way arising out of said construction work; and to fully protect, indemnify, and save harmless Metro and their employees from any and all payments of contributions, interest, or penalties, due or to become due to the Unemployment Compensation Fund of the State of Nebraska from Principal or any Contractor or Sub-Contractor because of or in any way arising out of said construction work.

15. If at any time within the period of the guarantee any of the aforesaid work shall, in the judgment of Metro or Metro's Representative require repair, or reconstruction, Metro or Metro's Representative shall notify the Principal to make the required repairs or to do the required work, and if said Principal shall neglect to proceed therewith promptly after service of such notice upon the Principal than Metro shall notify the Surety who shall promptly do such work. The word "promptly", as used in this paragraph shall mean as soon as possible, in situations, which threaten life or property; as soon as practical, in other situations.

16. At the expiration of the aforesaid period of guarantee applicable to any of said work done or caused to be done by Principal, the Principal and the Surety shall be released provided that the said work is in good and proper condition at the expiration of said period of guarantee and provided, further , that it shall be the duty of the Principal, or the Surety at its election, to arrange with Metro, no sooner than 30 days prior to the expiration of the guarantee period, for an inspection of the aforesaid work and, unless the Principal or Surety shall make such arrangements are made, the inspection conducted and a final certificate as to the good and proper condition of all of the aforesaid work shall have been duly issued or approved by Metro alone. If the Principal or Surety does not cause such an inspection to be made at the Principal's or Surety's expense before three months following the expiration of the guarantee period then Metro may make such an inspection at its own initiation. Any inspection conducted by Metro, whether at its own initiation or as arranged for by the Principal, shall be paid for in full by the Principal and Surety, or either of them.

17. To make payment in full for the material use, for all laborers and mechanics for labor that shall be performed upon all of the aforesaid work and for material and equipment rental which is actually used or rented in construction work or in the performance of the contract.

18. To furnish to Metro a photo static copy of an applicable contract or an executed duplicate original thereof, and such other instruments or documents pertaining to said construction work as it may require.

19. No payment by Principal or Surety under the provisions of this Bond shall be made other than to Metro, to any obligee name herein, without prior approval by Metro.

20. **Principal and Surety are jointly and severally liable under the provisions hereof and action against either or both may proceed without prior action against the other, and both may be joined in one action.

NOW, THEREFORE, the condition of this obligation is such that, if said Principal shall well and faithfully perform all of the Principal's obligations as foresaid, then these presents shall become void, other wise to remain in full force and effect.

IN WITNESS WHERE OF, we have hereunto set our hands this ___day of _____, 20___.
IN PRESENCE OF:

SURETY:	PRINCIPAL:
_____.	_____
Company Name	Company Name
_____	_____
Signature of Attorney in Fact	Signature of Company President
RESIDENT AGENT:	WITNESS:
_____	_____
Name	Name
_____	_____
Address	Address
_____	_____
City, State, Zip	City, State, Zip
_____	_____
Signature of Resident Agent	Signature of Witness

LABOR AND MATERIAL PAYMENT BOND

(This Bond is issued simultaneously with Performance Bond in favor of Metro conditioned on the full and faithful performance of the Contract.)

KNOW ALL MEN BY THESE PRESENTS: that _____ as Principal, hereinafter called Contractor, and _____ as Surety, hereinafter called Surety, are held and firmly bound unto **The Regional Metropolitan Transit Authority of Omaha d/b/a Metro, 2222 Cuming Street, Omaha, NE 68102**, hereinafter called Metro, for the use and benefits of claimants as herein below defined, in the amount of _____, for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated_____, entered into a contract with Metro for the **Boilers Replacement Project, NE-90-X144 Specification No. 04-26, 2222 Cuming Street, Omaha, NE** in accordance with Drawings and Specifications prepared by Metro's Representative, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Contractor or with a Subcontractor of the Contractor for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental or equipment directly applicable to the Contract.

2. The above named Contractor and Surety hereby jointly and severally agree with Metro that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgement for such sum or sums as may be justly due claimant, and have execution thereon. Metro shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant;

    a) Unless claimant, other than one having a direct contract with the Contractor, shall have given written notice to any two of the following: The Contractor, Metro, or the Surety above named, within one hundred eighty (180) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Contractor, Metro or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

    b) After the expiration of one (1) year following the date on which Contractor ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so

as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4. The amount of this Bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this Bond.

THE GENERALITY OF OTHER SECTIONS of this Bond shall not in any way be limited by the following:

It is expressly understood and agreed that this Bond is given to secure and does secure payment by the said bounden Contractor of all just claims for material, supplies, tools, fuel, lubricants, equipment, equipment rental, machinery, insurance premiums, and services used or consumed in the construction of the work by him or any of his subcontractors and for the payment to the Unemployment Compensation Fund of the State of Nebraska the unemployment contributions and interest due under the provisions of Nebraska Law on wages paid to individuals employed in the performance of this contract, and for all other just claims filed against the Contractor or any of his subcontractors in carrying out the provisions of this contract.

Contractor:_____ (Seal)

Title:_____

Surety:_____ (Seal)

Title:_____

Agent of Record: _____

Address of Agent of Record: Address of Surety Company:

_____ _____

Phone Number: _____ Phone Number: _____

MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____ as Principal, hereinafter called Contractor, and _____ as Surety, hereinafter called Surety, are held and firmly bound unto **The Regional Metropolitan Transit Authority of Omaha d/b/a Metro, 2222 Cuming Street, Omaha, NE 68102**, hereinafter called Metro, in the amount of _____Dollars and ___/100 *($_____),* for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The Principal has constructed the Boilers Replacement Project as identified as NE-90-X144, SPEC NO. 04-26, in Omaha, Nebraska. These improvements were constructed according to final construction plans approved by Metro on **March 13,2026.** The Principal agrees as a condition of final approval of said construction to warrant Metro that the construction is, and will remain for **a period of two (2) years** from the date of substantial completion, free from defects in materials and workmanship.

The condition of obligation is such that if Principal shall fully perform according to the terms of the final construction plans and the warranty described above, and if no claim on said warranty is unsatisfied at the conclusion of thirty days following the two-(2) year warranty period, then this obligation shall be void, otherwise to remain in full force and effect.

Project Name:_____ Date:_____

Principal:_____ Corporate Surety_____

By:_____ Address:_____

City, State, Zip:_____

By:_____

Title:_____

Date of Substantial Completion:_____

By:_____

CERTIFICATE AS TO CORPORATE CONTRACTOR

I, _____, certify that I am the (Assistant) Secretary of the corporation named as Contractor in the within bond; that _____, who signed the said bond on behalf of the Contractor was then _____ of said corporation; that I know his/her signature thereto is genuine; and that said bond was duly signed, sealed, and attested to for and in behalf of said corporation by authority of its governing body.

(Corporate Seal)_____
(Signature of Corporate Secretary or Assistant Secretary)

ACKNOWLEDGMENT OF CONTRACTOR
(If not a Corporation)

STATE OF _____)
County of _____):ss

On this _____ day of _____ in the year 20___, before me
personally appeared _____, known to me to be the person who is described in, and who executed the within instrument, and acknowledged to me that he/she or they executed the same.

_____
My Commission Expires: (Signature of Notary Public)

Seal:_____

ACKNOWLEDGMENT OF SURETY

STATE OF _____)
County of _____):ss

On this _____ day of _____ in the year 20___, before me, a Notary Public, personally appeared _____, known to me to be the _____ of the corporation that is described in and that executed the within instrument, and acknowledged to me that such corporation executed the same, that he/she is _____ of the corporation described in and which executed the foregoing instrument; that he/she knew the seal of the corporation; that the seal affixed to said instrument was such corporate seal; that it was so affixed by order of the Board of Directors of said corporation; and that he/she signed his name thereto by like order.

_____
My Commission Expires: (Signature of Notary Public)

Seal:_____

POWER OF ATTORNEY TO BE ATTACHED

SUPPLEMENT TO CERTIFICATE OF INSURANCE

(Liability Policies)
Standard Form No. 1198

This is to certify that the endorsements described below have been issued by the named insurance companies. This supplement does not extend coverage shown on any attached endorsements.

PROJECT: Boilers Replacement Project; NE-90-X144 SPEC NO. 04-26

METRO: The Regional Metropolitan Transit Authority of Omaha, d/b/a Metro, 2222 Cuming Street, Omaha, Ne 68102

ENGINEER: SRF CONSULTING GROUP, INC.

NAMED INSURED - CONTRACTOR:

COMMERCIAL GENERAL LIABILITY INSURANCE

Insuring Company: _____ Address: _____

Policy No.: _____ Inception Date: _____ Expiration Date: _____

UMBRELLA EXCESS LIABILITY

Insuring Company: _____ Address: _____

Policy No.: _____ Inception Date: _____ Expiration Date: _____

AUTOMOBILE LIABILITY INSURANCE

Insuring Company: _____ Address: _____

Policy No.: _____ Inception Date: _____ Expiration Date: _____

The policy or policies have been endorsed to name Metro and Engineer as Additional Insured as respects to above named project only and as regards Contractors work only.

☐ Yes ☐ No

Endorsement [is] [is not] attached.

The policy or policies listed herein have been endorsed to provide that thirty (30) days prior notice by Registered Mail from the insuring Company (ies) shall be given to Metro and Engineer named in this certificate (and to _____) in the event of cancellation, non-renewal, reduction of limits or deletion of coverage of the policy (ies) by the insurer and that immediate notice to the same parties by Registered Mail shall be given in the event of cancellation, non-renewal, reduction of limits or deletion of coverage of the policies by the insured.

☐ Yes ☐ No

Endorsement [is] [is not] attached.

Are any of the above liability policies “claims made” type policies?

☐ Yes ☐ No

If yes, list policy Nos.

COVERAGE PROVIDED: (mark appropriate box)

(1) Operations of Contractor .....

(2) Operations of Sub-Contractor (Contingent) .....

(3) Elevators, if any .....

(4) Contractual Liability to include coverage for "Hold Harmless Agreement" if such agreement is contained in the contract documents or a sub-contract (in addition to coverage afforded for "incidental contract" as defined in policy)

PROPERTY DAMAGE INCLUDES: (mark appropriate box)

(1) Coverage for damage due to blasting .....

(2) Coverage for damage due to collapse.....

(3) Coverage for damage to underground facilities .....

(4) Broad Form Property Damage .....

Special limitations or conditions as respects entire policy: _____

_____

_____

(IF ENTRY IS MADE ON ABOVE 3 LINES, ATTACH A COPY OF POLICY EXCLUSIONS TO CERTIFICATE)

Dated at_____on_____ by:

_____ _____

Insuring Company (ies) *Signature of Authorized Agent(s)

_____

Printed Name of Agent(s)

Telephone No. Of Agency: _____

Name and Address of Agency_____

DIVISION 6-
AIA CONTRACT (DRAFT)

DRAFT

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

« »
« »

THE OWNER:
(Name, legal status and address)

« »« »
« »

THE ARCHITECT:
(Name, legal status and address)

« »« »
« »

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ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to

submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work
The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification
§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT
§ 4.1 General
§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract
§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications
The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not

prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes

in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- **.4** As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- **.1** Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- **.2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- **.3** Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- **.4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- **.5** Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the

Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification

by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated

by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in

whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change

Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter,

if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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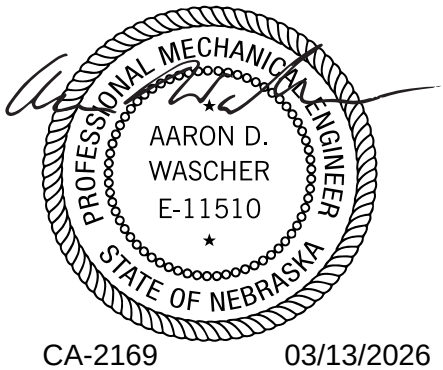

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SECTION 22 0400

COMMON REQUIREMENTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. This section describes the general requirements of these specifications and shall apply to all phases of the work indicated or required to provide for complete installation of all systems for this project.

B. This Section includes basic materials and methods to complement other Division 22 Sections.

1.2 WARRANTIES

A. Warrant all materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warrant period.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.3 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.4 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.5 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
1. Architect: Architect or Engineer
2. Code: All applicable national, state and local code
3. Mechanical: All plumbing, HVAC, & fire protection work required by the Contract Documents
4. Electrical: All electrical and fire alarm work required by the Contract Documents
5. Contractor: Any Contractor performing work required by the Contract Documents
6. Indicated: Shown on drawings, noted, scheduled or specified
7. Selected: Selected by the Architect or Engineer
8. Provide: Furnish, install, connect and tested complete and ready for use
9. Furnish: Supply and deliver to the site ready for installation
10. Install: Install complete, per Contract Documents and manufacturer's requirements.
11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and in parking garages.
14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to

outdoor ambient temperatures. Examples include installations within unheated shelters.

16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
    a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.6 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols shown on the plans.

1.7 ABBREVIATIONS

A. Refer to abbreviations list shown on the Drawings.

1.8 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. All work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
1. International Building Code (IBC)
2. International Energy Conservation Code (IECC)
3. International Fuel Gas Code (IFGC)
4. International Plumbing Code (IPC)
5. International Mechanical Code (IMC)
6. Safety and Health Regulations for Construction
7. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards
8. National Electrical Code (NEC)
9. National Fire Protection Association (NFPA)
10. Life Safety Code (NFPA 101)
11. American Gas Association (AGA)
12. Underwriters' Laboratories, Inc. (UL)
13. National Electrical Safety Code (NESC)
14. All applicable national, state and local codes and amendments.

1.9 PERMITS

A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them.

B. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.10 CODE COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that shown on the drawings shall not be substituted.

B. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

C. Where the National Electrical Code or applicable codes require controllers to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:
   1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
   2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
   3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
   4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufactures other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
      a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.

b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
c. The Contractor providing the substitution shall bear the total cost of all changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.

5. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.
6. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.

C. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

D. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:
1. Other section in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.
5. The shop drawing submittals shall be numbered consecutively under Specification Section 220400. The submittal subject shall clearly summarize the area or system being issued for review.
6. The product data submittal ID shall be numbered consecutively under the applicable Project Manual section, ending with the revision number. The submittal subject shall be the product data description.
a. For example, the first revision of the second submittal for product data specified in Section 220523 shall have an ID of ‘220523-002-1’.
7. Submittals not listed in the Project manual shall reference the respective contract document.
8. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.

a. Shop drawings and product data shall be in original searchable PDF format.

9. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for plumbing materials and equipment.
   a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
10. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
11. All submittals shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. All equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
12. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.
13. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.
14. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.

B. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work.
   1. Include the following:
      a. Planned piping layout, including valve and specialty locations and valve-stem movement.
      b. Clearances for installing and maintaining insulation.
      c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
      d. Equipment and accessory service connections and support details.
      e. Exterior wall and foundation penetrations.
      f. Fire-rated wall and floor penetrations.
      g. Sizes and location of required concrete pads and bases.
      h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
j. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access doors or panels and other hanging or ceiling-mounted items.
k. All Contractors are required to provide information concerning their part of the work needed to develop the coordination drawings.
l. Coordination Drawing Content:
    1) Drawings shall contain all of the following that are applicable:
        (a) Ductwork, equipment, and terminal devices (showing access and service requirements). Ductwork, equipment and terminal devices indicated in the coordination drawing content must be the same as that indicated in all submittals.
        (b) Plumbing
        (c) HVAC piping
        (d) Recessed, surface mount, and exposed hanging light fixtures
        (e) Electrical conduit 2 inches and larger
        (f) Cable tray
        (g) Fire sprinkler piping
        (h) Structure and general construction
        (i) Access doors and panels
        (j) Other areas indicated by the Contractor that involve congestion
    2) Complete drawings after submitting product data on items included in coordination drawings.

C. Operation and Maintenance Manuals:
1. Prepare electronic operation and maintenance manuals for the equipment furnished.
2. The manual shall be in original searchable PDF format with equipment organized by specification section. Bookmarking shall be provided in the PDF for each specification section and piece of equipment.
3. Manuals shall be submitted to the Architect for review and distribution to the Owner not less than 30 days prior to substantial completion of the project.
4. Manuals not meeting the requirements of this section may be rejected by the Architect.
5. Manual shall include, but shall not be limited to, the following:
    a. A cover page including:
        1) Project name and address
        2) Division of work covered by the manual
        3) Name, address and telephone number of Contractor and all Sub-Contractors including night or emergency numbers

b. A Complete Index. Contractor may submit the index to the Architect for review prior to submittal of complete manuals if desired.
c. Manufacturer's equipment product data O&M manuals and parts lists identified by the equipment mark used in the contract drawings.
d. Names, Addresses and Telephone Numbers. This list shall include the manufacturer and local representative who stocks or furnishes repair parts for all items of equipment and shall be typed on a single page in front of the manual.
e. Startup, Operation and Shutdown Procedures. Provide a written description of procedures for startup, operation and shutdown of each item or system. This description shall include motors to start, valves to open, etc., in proper sequence, and the location of switches, starters, pushbuttons and valves. Description shall include item references or labels used in the contract documents unless otherwise instructed in advance by the Owner.
f. Seasonal Changeover Procedure. Provide a written description of the procedure for necessary seasonable changeover from heating to cooling and vice versa.
g. Equipment Accessory Schedule. Upon completion of the work, furnish the Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required and the manufacturer of all renewable items.
h. Lubrication Schedule. Provide a chart listing each piece of equipment, the proper type of oil or grease required, and recommended frequency of lubrication.
i. Emergency Procedures. Provide a written description of emergency operating procedures or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency services to the various parts of the system.
j. One copy of all shop drawings.
k. Signed letters of certification of inspection and similar information.
l. All manufacturers' warranty information.
m. Provide documentation that training was performed for each item specified to include Owner training. Include name of Owner’s representative(s) present, date and time of training.
n. Normal Maintenance Schedule. Include a listing of work to be performed at various time intervals; i.e., 30, 90, 180 days and yearly.
o. Provide documentation that Extra Materials were received by the Owner for each section requiring Extra Materials.
p. Motor List. The list shall indicate motor location, equipment served (using labels indicated on drawings), horsepower, electrical characteristics, motor type, and rpm. Motors less than 1/2 horsepower need not be included.

1.13 OPERATING TRAINING

A. Complete operating instructions for each system and item of equipment shall be provided to the Owner's designated personnel.

B. Operation and Maintenance Manuals must be reviewed and accepted by the Architect and provided to the Owner prior to operating training.

C. Training shall be scheduled at the convenience of the Owner. A minimum of 4 hours, per system, of training shall be provided.

D. Training shall include instructions on the following:
   1. Startup and shutdown procedures
   2. Seasonal changeover
   3. Periodic maintenance
   4. Emergency operation
   5. Safety

E. In addition to the instructions required above, wherever possible perform the operations being described in order to fully illustrate system operation.

F. At the completion of training, turn over to the Owner all required keys and special tools for installed equipment. Each key or tool shall be labeled with its use.

1.14 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, “Structural Welding Code-Steel”.

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications”.
   1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping”.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.16 COORDINATION

A. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

B. Provide offsets and elevation changes in piping as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

C. Arrange for spaces, chases, slots, and openings in building structure during progress of construction to allow for system installations.

D. Coordinate arrangement, mounting, and support of equipment.
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.

E. Coordinate routing of all piping in open and exposed areas with light fixture locations. Where piping will be installed at or below the mounting height of lights, piping shall not pass directly below or within a proximity that will create an obstruction to the required light pattern. Deviations and/or conflicts discovered in the field shall be resolved, to owner/architect/engineer satisfaction, at no additional cost to the project.

F. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

G. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

H. Coordinate service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing water, gas, electrical power and other services.

I. Coordinate location of access panels and doors for items that are concealed by finished surfaces.

J. Coordinate testing of items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.17 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted mechanical, electrical, plumbing system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Design Professionals for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

D. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

PART 2 PRODUCTS

2.1 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Specific Notes and/or Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.2 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. Where the National Electrical Code or applicable codes require equipment to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment. Acceptable methods of complying with this requirement are as follows:
   1. Provide SCCR rating at the equipment that meets or exceeds the available short circuit current at the switchboard or panelboard where the equipment circuit originates.
   2. Provide calculations, based on the available short circuit current at the switchboard or panelboard where the equipment circuit originates, that document

the actual short circuit current available at the equipment. The SCCR rating of the equipment shall meet or exceed this calculated value.

2.3 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.4 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.5 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.6 SEALANTS AND FIRESTOPPING

A. Manufacturers:
   1. Sealants:
      a. Dow Corning
      b. Pecora
      c. Sonneborn
      d. Tremco
   2. Firestopping Materials and Systems:
      a. A/D Fire Protection Systems Inc: www.adfire.com.
      b. 3M Fire Protection Products: www.3m.com/firestop.
      c. Hilti, Inc: www.us.hilti.com.
      d. Nelson FireStop Products: www.nelsonfirestop.com.
      e. Specified Technologies, Inc: www.stifirestop.com.
      f. Tremstop Fyre-Sil Sealant - Tremco Sealants & Coatings

B. Silicone Sealant: Single component, air curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type for application in vertical joints and in horizontal joints, color as selected.

C. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

D. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

E. Joint Backing: ANSI/ASTM D1056; round, closed cell, polyethylene foam rod; oversized 30% to 50% larger than joint width.

F. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

G. Firestopping Materials and Systems:
1. UL Listed products and assemblies.
2. Subject to compliance with the requirements of Division 07 Fire and Smoke Protection.

2.7 ACCESS DOORS

A. Manufacturers:
1. Access Doors:
a. J. L. Industries
b. Karp Associates, Inc.
c. Larsons Mfg. Co.
d. Milcor, Inc.
e. Miller Limited Partnership
f. Nystrom, Inc.

B. Prime coated 14 gauge steel, flush, with screwdriver operated cam lock, frame to accommodate construction type; size as indicated.

2.8 ELECTRICAL WIRE

A. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. All wiring running exposed in return air plenums shall be plenum-rated cable for fire and smoke spread.

2.9 LOW VOLTAGE CONTROL WIRE AND CABLE

A. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC, and General Purpose Cabling:
1. Cable shall consist of copper conductors not less than #18 AWG stranded.
2. Cable shall be two- or three-conductor twisted cable with a drain wire.
3. Cable shall have a 100 percent overall shield.
4. Cable shall be plenum rated.
5. Cable shall meet or exceed NEC voltage rating of 300 volts.
6. Cable shall be NEC type CMP.
7. Cable shall meet or exceed UL temperature rating of +60 deg C.

2.10 BACKFILL MATERIAL AND MIXES

A. Earth Fill: Approved type of soil classified, in accordance with ASTM D2487, as GW, GP, GM, GC, SW, SP, SM. SC, ML or CL, and free of foreign substances, obtained from

excavation on this project or other approved source, and having a plasticity index between 7.5 and 17.

B. Granular Fill: Granular fill shall include clean, natural or prepared gravels, gravel-sand mixtures, sands or gravelly sands with little or no fines. A minimum of 95% shall be retained on a No. 200 sieve.

C. Pea Gravel: Pea gravel shall consist of clean, hard, round particles of crushed stone, crushed or uncrushed gravel with the following gradation:

Sieve Size	Percent Passing
3/8 inch	85 - 95
#4	55 - 15
#8	0 - 2

D. Crushed Rock: Crushed rock shall consist of clean, hard, particles of crushed limestone, dolomite, granite, quartzite, or other approved rock. It shall have a percentage of wear of not more than 45 and a percent loss of not more than 30 at the end of 16 cycles of the freezing and thawing test. Gradation for crushed rock shall be as follows:

Sieve Size	Percent Retained
1-1/2 inch	0
3/4 inch	5 - 35
3/8 inch	30 - 64
#10	70 - 90
#200	900 - 100

PART 3 EXECUTION

3.1 GENERAL

A. Fabrication, erection, and installation of the complete system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. The Contractor shall check all areas and surfaces where plumbing equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the plumbing work.

D. Equipment and systems shall be installed in accordance with manufacturer's instructions, requirements, or recommendations.

3.2 DELIVERY AND STORAGE OF MATERIALS

A. Take provisions for the delivery and safe storage of materials and shall make the required arrangements with other Contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. All items subject to cold weather damage shall be protected by covering, insulating, or storing in a heated space.

3.3 COOPERATION WITH OTHER CONTRACTORS

A. Perform the work in conformance with the construction called for by other trades and afford other Contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the work with the work of other Contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the plumbing work which might prevent prompt and proper installation of work required from other trades.

3.4 COORDINATION OF WORK

A. The list below is the precedence of assigned work items for space priority in descending order. Items not listed shall have the same precedence as similar items:
   1. In areas with finished ceilings: Reflected ceiling with all light fixtures, access above light fixtures required for maintenance, sprinkler head locations, and all ceiling fixtures and devices.
   2. Gravity flow plumbing waste, roof drainage, and other systems that rely upon gravity for flow.
   3. Ductwork and appurtenances, except that external bracing shall be relocated to accommodate local interference.
   4. In open and exposed areas: Exposed and surface mounted light fixtures and signs.
   5. Fire sprinkler piping.
   6. Cable tray with access identification 8 inches horizontal to 6 inches above tray.
   7. Electrical conduit over 2 inches in diameter.
   8. HVAC piping except for pressurized domestic water piping.
   9. Plumbing vents.
   10. Electrical conduit under 2 inches in diameter.

B. Plan all work so it proceeds with a minimum of interference with other trades.

C. It shall also be the responsibility of the Contractor to inform the General Contractor of all openings required in the building construction for the installation of the plumbing work.

D. The Contractor shall cooperate with all other contractors in furnishing material and information, in proper sequence, for the correct location of all sleeves, inserts, foundations, wiring, etc.

E. Provisions shall be made for all special frames, openings, and sleeves as required.

F. The Contractor shall pay for extra cutting and patching made necessary by their failure to properly direct such work at the correct time.

3.5 ELECTRICAL WIRING

A. Install wiring in accordance with National Electrical Code and ANSI/NFPA 70.

B. Install wiring (low and line voltage) in metal raceways or conduit unless inside control cabinet or unit enclosures. For concealed and accessible areas, plenum-rated wiring and cabling may be used.

C. Class 2 wiring not installed in conduit shall be supported every five feet from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

D. Low voltage control wiring and 24 VAC can be run in the same conduit. Power wiring 120 VAC and greater must be in a separate conduit.

E. Fastening shall be secured to walls or ceilings by means of appropriate screws, expansion screws anchors, toggle bolts, hollow wall screw anchors, nylon expansion anchors, or expansion shields. All-purpose plastic anchors are not acceptable.

F. Control panels shall be mounted on vibration-free walls or freestanding structural supports. Panels shall be located as indicated or approved by the Owner's Representative.

G. Locate circuits, relays, transformers, or other equipment that contains or must be connected to voltages exceeding 130 volts, in separate cabinets, which may be adjacent to control panels; permanently label "DANGER 277 VOLTS" or appropriate volts.

H. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size shall be 3/4 inch.

3.6 CONTROL AND POWER WIRING

A. Provide all incidental wiring required to make the fixtures, equipment or systems fully operational. Coordinate with equipment manufacture incidental power and control wiring requirements.

B. Incidental wiring includes but not limited to:
1. Plumbing Fixture power and control:

a. Faucets
b. Flush valves
c. Transformers
d. Flow switches
e. Alarms

2. Water Heaters
3. Automated flue exhaust system
4. Equipment Motors Starters
5. Manual Multi-Speed Switches (Furnished as an Accessory to Plumbing Equipment)
6. Pushbutton Stations and Emergency Stop Switches
7. Pumps
8. Remote Monitoring and Control Panels (Provided by Equipment Manufacturers)
9. Gas and utility emergency shut-off system

3.7 LAYING OUT WORK

A. Carefully lay out all work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings, and shop drawings.

B. Equipment layout and all system layouts shall confirm adequate clearances for installation, operation, maintenance, and code-required clearances from the structure or other equipment and systems.

C. Provide offsets and elevation changes in piping as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

D. The layout shall not cause problems of operation, maintenance, or clearance for items installed by other Contractors.

E. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

F. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and shall request clarification.

G. Failure to properly coordinate and lay out the work will require correction by the Contractors at their own expense.

3.8 DATA AND MEASUREMENTS

A. Drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and shall adapt their work to actual conditions.

D. Examine the general construction, mechanical, electrical, and other applicable drawings and the Specifications.

E. Only architectural drawings, structural drawings, and site measurements may be utilized in calculations.

F. Layout and coordinate all work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

3.9 POSITION OF DEVICES

A. Locate devices mounted on finished surfaces with regard to paneling, furring, trim, etc. Where several devices occur in a room, they shall be symmetrically arranged as reviewed by the Architect.

B. Devices improperly located or installed shall be repaired, replaced or relocated at the Contractor's expense.

C. Devices shall be set plumb or horizontal and shall extend to the finished surface of the wall, ceiling, or floor without projecting beyond the surface.

D. Devices shown on wood trim, cases, or other fixtures shall be installed symmetrically and, where necessary, shall be set with the long dimension of the plate horizontal.

E. Coordinate their respective devices so as not to destroy the aesthetic effect of the surface in which the devices are mounted.

F. Coordinate the locations of all plumbing items with work furnished by other trades to avoid interference.

G. If the required coordination is not done, the outlets or devices shall be removed and relocated if so directed by the Architect and the damaged surfaces repaired at the Contractor's expense.

H. Devices shall be installed at the height shown below unless otherwise noted. All heights of devices are measured from finished floor to centerline of device.

I. Heights may be adjusted to correspond to nearest masonry course or as necessary to clear wall-mounted cabinets, fin tube convectors, unit heaters, etc.
   1. Control panels 48 inches.

3.10 PROTECTION OF APPARATUS

A. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment, and installations from damage of any kind.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.11 ACCESS TO EQUIPMENT

A. All motors, valves, control devices, specialties, etc., shall be located to provide for easy access for operation, repair and maintenance; if concealed, access doors shall be provided.

B. Access doors required for access to equipment requiring inspection or service shall be provided.

C. Provide all access doors not already furnished by other Contractors but which are required for access to plumbing equipment.

D. Doors shall be 12 inches by 12 inches unless shown otherwise.

E. Person access doors shall be 18 inches by 18 inches minimum.

3.12 EXAMINATION OF PREMISES

A. Examine the premises and all conditions thereon and/or therein. The bid proposal shall take into consideration all such conditions which may affect the work under this contract.

3.13 ROADWAYS, CURBS, AND WALKS

A. Use every possible precaution to prevent injuries to roadways, curbs, and walks on or adjacent to the site of the work.

B. Any damage shall be repaired at the Contractor's own expense. This shall also include damage necessary for installation of the plumbing work.

3.14 INSULATION

A. Continue pipe insulation through walls, floors, sleeves, hangers, and other penetrations.

B. Insulate pipe fittings, joints, valves, unions, flanges, strainers, flexible connections and expansion joints with insulation of like material and thickness as adjoining pipe.

C. Provide insulation jackets and/or covers as indicated.

3.15 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install as described below, unless individual Sections specify otherwise. Individual Sections specify unique installation requirements.

B. Refer to The Plumbing Fixture Schedule for all plumbing piping connection sizes to all plumbing fixtures.

C. Wall hydrants and downspout nozzles shall be installed between 18" and 24" above finished grade. Provide accessible shutoff valve located indoor for each wall hydrant.

D. Piping in exterior building walls shall be located on the warm side of building insulation and vapor barrier. Building insulation shall run continuous between piping and exterior of building.

E. PVC piping shall not be installed in return air plenums.

F. General Locations and Arrangements:
1. Drawing plans, schematics, and diagrams indicate general, diagrammatic location and arrangement of systems.
2. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
3. Install systems as indicated, unless deviations to layout are approved on Coordination Drawings.
4. Provide offsets and elevation changes in piping and conduit as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.
5. Refer to architectural exterior and interior elevations for wall mounted device locations.
6. Do not run piping above electrical or telecom panels or in code required clearance spaces.
7. Do not run piping and plumbing above or through information technology and data closets, IDF, and MDF rooms or associated riser rooms. Coordinate all routing with other trades.
8. Coordinate location of piping with electrical cable tray. Provide a minimum of 6" of clear access above cable tray for installation of cables.
9. Install all horizontal piping in mechanical rooms at a minimum of 7'-6" above finished floor.
10. Install exposed interior and exterior piping at right angles or parallel to building walls.
    a. Diagonal runs are prohibited, unless otherwise indicated.
11. Conceal piping in walls, pipe chases, utility chases, above ceilings, below grade or floors, unless otherwise noted, except in mechanical rooms or service areas.
12. Install piping to allow application of insulation plus 1-inch clearance around insulation.
13. Pipe hangers for insulated pipe with vapor barrier jackets shall be installed around the outside of the insulation and a metal insulation support shield provided to prevent crushing of the insulation.
14. Locate groups of pipes parallel to each other, spaced to permit insulation and valve servicing.
15. Dielectric nipples or flange insulation kits shall be utilized for all dissimilar pipe connections. Dielectric unions will not be accepted.
16. Install piping at indicated slope and as required by code.
17. Provide components with pressure rating equal to or greater than system operating pressure.

18. Install fittings for changes in direction and branch connections.
19. Install piping free of sags or bends with ample space between piping to permit proper insulation applications.
20. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building unless otherwise indicated.
    a. Allow sufficient space above ceiling panels to allow for ceiling panel removal.
21. Install piping to allow for expansion and contraction without stressing pipe, adjacent building structure or connecting equipment.
    a. Provide expansion loops or compensators where indicated.
22. Do not use ceiling support system to bear weight of devices or systems unless ceiling support system is certified as suitable to do so.
23. During construction, avoid any undue loads, forces or strains on valves, equipment, pumps flanges, or building elements with piping connections or piping systems.
24. Keep all pipe and equipment openings closed during construction except when actual work is being performed on that item or system.
25. Leaking pipe joints shall be remade using new materials.

G. Clean existing underground sanitary piping with cable and blade to first manhole prior to installation and connection of new piping.

H. Provide wall- and floor mounted sewer cleanouts as required by code. Coordinate location in field.

I. Locate plumbing vents through the roof at a minimum of 10'-0" away from all outdoor air intakes on HVAC equipment or operable windows.

J. Terminate all natural gas flue vents a minimum of 2'-0" higher than any surface or equipment within 10'-0" or as required by code.

K. Provide shut-off valves for water supply at all equipment items.

L. Coordinate finish floor elevations to set floor drains and floor sinks.

M. Saw cut and remove floor as required for installation of new piping.

N. Contractor is responsible for any cutting and patching needed for plumbing installation. Patching must match existing.

O. Verify final equipment locations for roughing-in of all systems.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.16 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom while maintaing accessible ladder access, if mounting heights are not indicated.

B. Install equipment according to manufacturer's requirements and submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Provide access space around terminal units and heat pumps as required per manufacturers' recommendations. Do not route piping under terminal unit or heat pump.

D. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

E. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components.

F. Connect equipment for ease of disconnecting, with minimum interference to other installations.

G. Install equipment giving right of way to piping installed at required slope.

H. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.17 EXCAVATION

A. Perform excavation of every description and of whatever substances encountered, to the depths required or indicated on the drawings, in accordance with OSHA.

B. During excavation, deposit material suitable for backfill in an orderly manner a sufficient distance from the excavation banks to avoid overloading and to prevent slides or cave-ins.

C. Dispose of material unsuitable for backfill as directed by the Architect.

D. Grade as necessary to prevent surface water from flowing into trenches or other excavations, and remove any water accumulating therein by pumping or by other acceptable method.

E. Fill any excess excavation below the levels indicated for structures or raceways with sand, gravel or concrete.

F. Unsuitable Material:
   1. Where the bottom of the trench is found to be unstable or to include ashes, cinders, any types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material, which in the judgment of the Architect should be removed, excavate and remove such unsuitable material to a minimum depth of 12 inches below the piping.

2. Backfill the trench with selected bedding material and compact to provide uniform and continuous bearing for the piping.
3. Dispose of the unsuitable material.

G. Shoring Requirements:
1. Perform shoring and sheeting that is required to protect the excavation and to safeguard employees in accordance with OSHA.
2. Widen excavation to provide for space occupied by shoring and sheeting.
3. Shoring shall meet the requirements of applicable codes and regulations.

H. Dewatering:
1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
2. Do not allow water to accumulate in excavations.
3. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.
4. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
5. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas.
6. Do not use trench excavations as temporary drainage ditches.

3.18 BACKFILL

A. Do not backfill until required inspections are made and tests are performed for the specific utility.

B. Backfill with the excavated materials specified for backfilling, consisting of earth, loam, sandy clay, sand and gravel or other materials, free from large clods of earth or stones.

C. Do not use broken concrete as backfill materials.

D. Do not backfill in freezing weather or with frozen material.

E. Adjust the moisture content of the backfill material if required for proper compaction.

F. Reopen any trenches improperly backfilled, or where settlement occurs, to the depth required for proper compaction, refill and compact to specified density.

G. Compact backfill for structures to the specified density.

H. During the backfilling of each exterior underground piping system, install continuous underground type plastic line markers.
1. Locate markers directly over the buried piping at 12 inches to 18 inches below finished grade.

2. Where multiple small piping are buried in common trenches and do not exceed an overall trench width of 16 inches, install a single line marker.

I. Deposit suitable backfill material around the piping in 6-inch layers and thoroughly compact by hand, machine tamper, or other suitable equipment.

J. Backfill to at least 90 percent of maximum density at optimum moisture content determined by ASTM D698 until the piping has a minimum cover of 2 feet.

K. The moisture content of the soil at time of compaction shall be not more than 3 percent above or 3 percent below the optimum.

L. Be careful not to disturb the piping.

M. Carry backfilling on simultaneously on both sides of the piping to eliminate the possibility of lateral displacement.

N. Return surface to original condition.

3.19 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.20 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
1. Clean surfaces that will come into contact with grout.
2. Provide forms as required for placement of grout.
3. Avoid air entrapment during placing of grout.
4. Place grout, completely filling equipment bases.
5. Place grout on concrete bases to provide smooth bearing surface for equipment.
6. Place grout around anchors.
7. Cure placed grout according to manufacturer's written instructions.

3.21 INCIDENTAL WORK

A. The following incidental work shall be furnished by the designated contractor under the supervision of the Temperature Control Contractor:
1. The Piping Contractor shall provide all necessary valved pressure taps, water, drain, and overflow connections and piping.
2. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.

3. The Electrical Contractor shall provide power wiring to the variable frequency controller.

3.22 EQUIPMENT AND SYSTEM SOFTWARE INTERFACES TO THE BMCS

A. Contractor shall coordinate with the BMCS Contractor to determine the points that are to be mapped from the equipment and systems to the BMCS. Contractor shall provide details of the method of integration and the information to be transferred between the systems as part of the submittal package.

B. Contractor shall provide the necessary software communication ports specifically for the interfacing of the systems to the BMCS.

C. Contractor cannot document that the exact same interface has been performed between the selected BMCS and the equipment and/or system, then the interfaces shall be tested prior to installations at an offsite location. The equipment shall not be installed at the project location until all software interfaces to the BMCS have been successfully demonstrated or documented.

D. Documentation regarding the software interfaces shall be provided in sufficient detail as to enable a person reasonably skilled in the writing of real time software applications to add/delete points mapped from one system to the other. The documentation shall include a detailed description of each protocol used and the model, version and firmware details of any protocol converter (gateway) that is used.

E. Refer to BMCS specifications for coordination and testing requirements.

3.23 LUBRICATION, TESTING AND TEST REPORTS

A. Upon completion of the work, the entire system shall be tested and proven for capacity of equipment, balance of system, proper operation of controls, and comfort of conditioned spaces.
   1. Prior to beginning systems testing, adjusting and balancing, replace all filter media with new media.
   2. Take air and water flow readings and submit copy of same to demonstrate proper flow according to the performances shown on the plans and noted in the specifications.
   3. Motors shall be checked for overload and belts adjusted.
      a. Align pulleys and install belts according to manufacturer's written instructions.
      b. Tension according to manufacturer's written instructions.
   4. Lubricate moving parts and clean or replace filters.
      a. Run in all bearings and, after they are run in, drain and flush bearings and refill with a new oil charge.
      b. Equipment shall be so arranged that tools (screwdrivers, wrenches, etc.) will not be required to make lubrication points accessible.
      c. Extensions on grease or oil fittings shall be provided where required for access to lubricate.

5. Test piping systems per applicable codes and standards.
6. Submit copies of all tests to the Architect for review prior to date of substantial completion.
7. Equipment and systems discrepancies shall be corrected prior to final acceptance.

END OF SECTION

SECTION 22 1005

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Natural gas piping, above grade.

1.2 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

E. Project Record Documents: Record actual locations of valves.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements for additional provisions.
2. Valve Repacking Kits: One for each type and size of valve.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, solder, and flux (if used), complying with NSF 61 and NSF 372; label pipe and fittings.

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

B. Flexible Gas Piping:
   1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
   2. Comply with ASTM E84.
   3. Fittings: Provided by piping system manufacturer.
   4. Provide piping with integral lightning protection.
   5. Manufacturers:
      a. Omega Flex, Inc; TracPipe CounterStrike: www.omegaflex.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
   1. Fittings: ASME B16.26, cast bronze.
   2. Joints: Flared.

D. Copper Tube: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
   2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
   3. Mechanical Press Sealed Fittings: ANSI LC 4/CSA 6.32; ICC (IFGC) approved, and IAPMO (UPC) or IAPMO (UMC) approved, with HNBR seals.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 0516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; see Section _____.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

K. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.

L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

M. Sleeve pipes passing through partitions, walls, and floors.

N. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

O. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every ____ floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.

9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 22 0548.

P. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

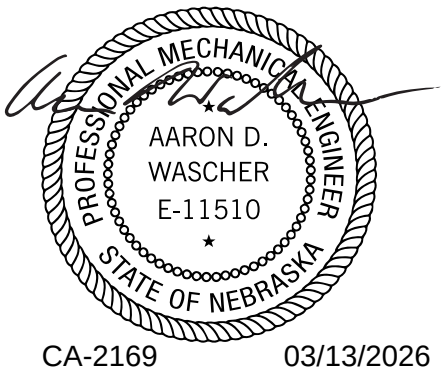
3.3 FIELD TESTS AND INSPECTIONS

A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.

B. Gas Distribution Systems:
1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
2. General Systems:
a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.
3. Welded Pipes or Systems with Service Pressures Above 14 in-wc:
a. Inject a minimum of 60 psi of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound with 1 psi increments.

C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

END OF SECTION



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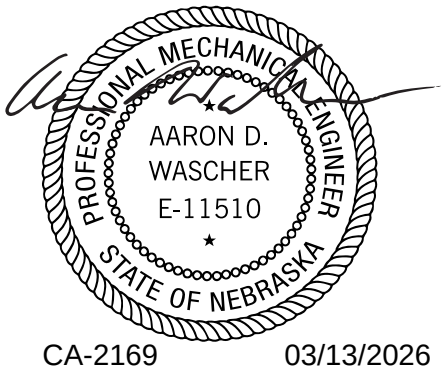

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SECTION 23 0400

COMMON REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic materials and methods to complement other Division 23 Sections.

1.2 WARRANTIES

A. Warrant all materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warrant period.
   1. Repair or replacement of compressorized equipment shall include a complete refrigerant charge.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.3 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.4 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.5 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
1. Architect: Architect or Engineer
2. Code: All applicable national, state and local code
3. Mechanical: All plumbing, HVAC, & fire protection work required by the Contract Documents
4. Electrical: All electrical and fire alarm work required by the Contract Documents
5. Contractor: Any Contractor performing work required by the Contract Documents
6. Indicated: Shown on drawings, noted, scheduled or specified
7. Selected: Selected by the Architect or Engineer
8. Provide: Furnish, install, connect and tested complete and ready for use
9. Furnish: Supply and deliver to the site ready for installation
10. Install: Install complete, per Contract Documents and manufacturer's requirements.
11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to

outdoor ambient temperatures. Examples include installations within unheated shelters.

16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
    a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.6 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols shown on the plans.

1.7 ABBREVIATIONS

A. Refer to abbreviations list shown on the Drawings.

B. The following abbreviations apply throughout the Contract Documents:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. ADA: Americans with Disabilities Act
3. AHJ: Authority Having Jurisdiction
4. AMCA: Air Moving Council of America
5. ANSI: American National Standards Institute
6. ARI: American Refrigeration Institute
7. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
8. ASME: American Society of Mechanical Engineers
9. ASTM Specification: Standard specifications of the American Society for Testing Materials
10. CPVC: Chlorinated polyvinyl chloride plastic.
11. CR: Chlorosulfonated polyethylene synthetic rubber.
12. EPDM: Ethylene propylene diene terpolymer rubber.
13. FM: Factory Mutual Engineering Corporation
14. IRI: Industrial Risk Insurers
15. NEC: National Electrical Code, latest edition
16. NEMA: National Electrical Manufacturers Association
17. NFPA: National Fire Protection Association
18. NP: Nylon plastic.
19. NPS: Nominal Pipe Size
20. PE: Polyethylene plastic.

21. PVC: Polyvinyl chloride plastic.
22. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
23. UL or Underwriters: Underwriters Laboratories, Inc.

1.8 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. All work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
1. International Building Code (IBC)
2. International Fire Code (IFC)
3. International Energy Conservation Code (IECC)
4. International Fuel Gas Code (IFGC)
5. Omaha Plumbing Code (OPC)
6. International Mechanical Code (IMC)
7. Safety and Health Regulations for Construction
8. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards
9. National Electrical Code (NEC)
10. National Fire Protection Association (NFPA)
11. Life Safety Code (NFPA 101)
12. American Gas Association (AGA)
13. Underwriters' Laboratories, Inc. (UL)
14. National Electrical Safety Code (NESC)
15. All applicable national, state and local codes and amendments.

1.9 PERMITS

A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them.

B. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.10 CODE COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that indicated shall not be substituted.

B. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

C. Where the National Electrical Code or applicable codes require controllers to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:
1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufactures other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.
b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
c. The Contractor providing the substitution shall bear the total cost of all changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
d. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.
e. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.
f. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

g. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:

1. Other section in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.
5. Submittals shall be labeled indicating the specification number and title, shop drawing or product data description and the respective Part 2 paragraph and sub-paragraph numbers.
6. Submittals not listed in the Project manual shall reference the respective contract document.
7. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.
   a. Shop drawings and product data shall be in original searchable PDF format.
8. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
   a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
9. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
10. All submittals shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. All equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
11. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect.
12. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.

13. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.
14. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.

B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work.
1. Include the following:
    a. Actual equipment being provided. Refer to manufacturer's data for physical size, access and maintenance requirements. Provide all code required clearances.
    b. Planned piping layout, including valve and specialty locations and valve-stem movement.
    c. Clearances for installing and maintaining insulation.
    d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
    e. Equipment and accessory service connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Fire-rated wall and floor penetrations.
    h. Sizes and location of required concrete pads and bases.
    i. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
    j. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
    k. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access doors or pabels and other ceiling-mounted items.
    l. All Contractors are required to provide information concerning their part of the work needed to develop the coordination drawings.
    m. Drawings shall contain all of the following that are applicable:
        1) Ductwork, equipment, and terminal devices (showing access and service requirements). Ductwork, equipment and terminal devices indicated in the coordination drawing content must be the same as that indicated in all submittals.
        2) Plumbing
        3) HVAC piping
        4) Recessed light fixtures
        5) Electrical conduit 2 inches and larger
        6) Cable tray
        7) Fire sprinkler piping
        8) Structure and general construction

9) Access doors and panels
10) Other areas indicated by the Contractor that involve congestion

n. Complete drawings after submitting product data on items included in coordination drawings.

C. Operation and Maintenance Manuals:

1. Prepare electronic operation and maintenance manuals for the equipment furnished.
2. The manual shall be in original searchable PDF format with equipment organized by specification section. Bookmarking shall be provided in the PDF for each specification section and piece of equipment.
3. Manuals shall be submitted to the Architect for review and distribution to the Owner not less than 30 days prior to substantial completion of the project.
4. Manuals not meeting the requirements of this section may be rejected by the Architect.
5. Manual shall include, but shall not be limited to, the following:
   a. A cover page including:
      1) Project name and address
      2) Division of work covered by the manual
      3) Name, address and telephone number of Contractor and all Sub-Contractors including night or emergency numbers
   b. A Complete Index. Contractor may submit the index to the Architect for review prior to submittal of complete manuals if desired.
   c. Manufacturer's equipment product data O&M manuals and parts lists identified by the equipment mark used in the contract drawings.
   d. Names, Addresses and Telephone Numbers. This list shall include the manufacturer and local representative who stocks or furnishes repair parts for all items of equipment and shall be typed on a single page in front of the manual.
   e. Startup, Operation and Shutdown Procedures. Provide a written description of procedures for startup, operation and shutdown of each item or system. This description shall include motors to start, valves to open, etc., in proper sequence, and the location of switches, starters, pushbuttons and valves. Description shall include item references or labels used in the contract documents unless otherwise instructed in advance by the Owner.
   f. Seasonal Changeover Procedure. Provide a written description of the procedure for necessary seasonable changeover from heating to cooling and vice versa.
   g. Equipment Accessory Schedule. Upon completion of the work, furnish the Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required and the manufacturer of all renewable items.
   h. Lubrication Schedule. Provide a chart listing each piece of equipment, the proper type of oil or grease required, and recommended frequency of lubrication.

i. Emergency Procedures. Provide a written description of emergency operating procedures or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency services to the various parts of the system.
j. One copy of all shop drawings.
k. Signed letters of certification of inspection and similar information.
l. All manufacturers' warranty information.
m. Provide documentation that training was performed for each item specified to include Owner training. Include name of Owner's representative(s) present, date and time of training.
n. Normal Maintenance Schedule. Include a listing of work to be performed at various time intervals; i.e., 30, 90, 180 days and yearly.
o. Provide documentation that Extra Materials were received by the Owner for each section requiring Extra Materials.
p. Motor List. The list shall indicate motor location, equipment served (using labels indicated on drawings), horsepower, electrical characteristics, motor type, and rpm. Motors less than 1/2 horsepower need not be included.

1.13 OPERATING TRAINING

A. Complete operating instructions for each system and item of equipment shall be provided to the Owner's designated personnel.

B. Operation and Maintenance Manuals must be reviewed and accepted by the Architect and provided to the Owner prior to operating training.

C. Training shall be scheduled at the convenience of the Owner. A minimum of 4 hours, per system, of training shall be provided.

D. Training shall include instructions on the following:
1. Startup and shutdown procedures
2. Seasonal changeover
3. Periodic maintenance
4. Emergency operation
5. Safety

E. In addition to the instructions required above, wherever possible perform the operations being described in order to fully illustrate system operation.

F. At the completion of training, turn over to the Owner all required keys and special tools for installed equipment. Each key or tool shall be labeled with its use.

1.14 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel".

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications”.
   1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping”.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.16 COORDINATION

A. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

B. Provide offsets and elevation changes in piping, conduit and ductwork as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

C. Arrange for spaces, chases, slots, and openings in building structure during progress of construction to allow for system installations.

D. Coordinate arrangement, mounting, and support of equipment.
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.

E. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

F. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

G. Coordinate service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing water, gas, electrical power and other services.

H. Coordinate location of access panels and doors for items that are concealed by finished surfaces.

I. Coordinate testing of items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.17 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted mechanical, electrical, plumbing system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Design Professionals for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, ductwork, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for designing, furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

D. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

PART 2 - PRODUCTS

2.1 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Specific Notes and/or Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.2 SHORT-CIRCUIT CURRENT RATING (SCCR) FOR EQUIPMENT AND ASSOCIATED CONTROL PANELS

A. SCCR Compliance - Equipment manufacturers and suppliers shall provide a certified SCCR for all equipment and associated panels to be provided with equipment procured under these specifications. The certified SCCR rating shall be no less than the value of the available fault current at the switchboard or panel serving the equipment as indicated on the Division 26 Electrical Riser Diagrams. Manufacturer shall provide internal components that meet or exceed the SCCR rating required by these specifications. Manufacturer shall refer to the National Electrical Code (NEC), which is also known as NFPA 70, Article 100 for additional requirements

B. Supplemental SCCR Compliance Data - At the manufactures option, they may calculate the available fault current at the specific equipment connection point. Manufacturer shall obtain feeder size, breaker type and length of feeder from the Division 26 contractor. All calculations shall be submitted as part of the equipment submittal for review by the engineer.

C. Application of Labels - All equipment and control panels associated with equipment procured under these specifications shall have a permanently installed label provided by the manufacturer as a part of the equipment indicating the SCCR rating of the equipment. Labels shall comply with NEC Article 409 - Industrial Control Panels, and NEC Article 670 - Industrial Machinery.

2.3 CONTROL SYSTEM INTERFACES

A. Equipment and systems shall be able to interface and integrate to BMCS systems and sequences via vendor protocols including, as a minimum, BACnet, LonTalk and Modbus.

2.4 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.5 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.6 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 PIPE OR CONDUIT PENTERATION HOUSING & HOODS

A. Manufacturer:
   1. RPH; www.RoofPenetrationHousings.com

B. References:
   1. ICC-500, FEMA 320/361 – Third Party Tested to +225 mph
   2. ICC 2015 Energy Code – Third Party Tested to ASTM E 2078-13 Standard Test Method for Air Permeance of Building Materials
   3. ASTM E 1980 Solar Reflectance Index (SRI)
   4. FEMA P749 – Seismic Provisions

C. Lid and housing lined with insulation to a minimum value of R-19.

D. Warranty: 20 years.

E. Roof Mounted: Engineered penetration housing, accommodating up to 18 pipes/conduits-- cables, water, refrigeration, and power in one roof penetration with high rain tight integrity.

F. Roof penetration system is constructed of 14 gauge UV powder coated, welded, galvanized steel or aluminum with stainless steel hardware.
   1. Removable, gasketed lid to housing and housing to curb connection joints, pitched cover.

2. Exit seal construction to be manufactured in all aluminum construction and 100% Sil-X-14 silicone gaskets.
3. All seals must be protected from UV with an aluminum or stainless steel jacket.

G. Coordinate size of housing and hoods with all trades utilizing the penetration.

H. Furnish with 18-inch tall insulated curb and extensions for roof applications.

2.9 ROOF MOUNTED PIPE, DUCTWORK AND CONDUIT SUPPORT SYSTEMS

A. Manufactures:
1. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
2. Eaton, Dura-Blok.
3. Erico International Corporation: www.erico.com.
4. PHP Systems/Design, www.phpsd.com
5. Unistrut, UNIpier.

B. Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
1. Bases: UV resistant material, molded polycarbonate resin, HDPE or rubber.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Stut style, galvanized steel horizontal and vertical supports, attaching hardware.
4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
5. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
6. Height: Provide minimum clearance of 18 inches under pipe to top of roofing.
a. Adjustable mounting height.
7. Operating temperature: -30F to 150F.

2.10 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psig, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.11 SEALANTS AND FIRESTOPPING

A. Manufacturers:
1. Sealants:
a. Dow Corning
b. Pecora

c. Sonneborn
d. Tremco

2. Firestopping Materials and Systems:
a. A/D Fire Protection Systems Inc: www.adfire.com.
b. 3M Fire Protection Products: www.3m.com/firestop.
c. Hilti, Inc: www.us.hilti.com.
d. Nelson FireStop Products: www.nelsonfirestop.com.
e. Specified Technologies, Inc: www.stifirestop.com.
f. Tremstop Fyre-Sil Sealant - Tremco Sealants & Coatings

B. Silicone Sealant: Single component, air curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type for application in vertical joints and in horizontal joints, color as selected.

C. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

D. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

E. Joint Backing: ANSI/ASTM D1056; round, closed cell, polyethylene foam rod; oversized 30% to 50% larger than joint width.

F. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

G. Firestopping Materials and Systems:
1. UL Listed products and assemblies.
2. Subject to compliance with the requirements of Division 07.

2.12 ACCESS DOORS

A. Manufacturers:
1. Access Doors:
a. J. L. Industries
b. Karp Associates, Inc.
c. Larsons Mfg. Co.
d. Milcor, Inc.
e. Miller Limited Partnership
f. Nystrom, Inc.

B. Prime coated 14 gauge steel, flush, with screwdriver operated cam lock, frame to accommodate construction type; size as indicated.

2.13 ELECTRICAL WIRE

A. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. All wiring running exposed in return air plenums shall be plenum-rated cable for fire and smoke spread.

2.14 LOW VOLTAGE CONTROL WIRE AND CABLE

A. All wiring materials section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC, and General Purpose Cabling:
1. Cable shall consist of copper conductors not less than #18 AWG stranded.
2. Cable shall be two- or three-conductor twisted cable with a drain wire.
3. Cable shall have a 100 percent overall shield.
4. Cable shall be plenum rated.
5. Cable shall meet or exceed NEC voltage rating of 300 volts.
6. Cable shall be NEC type CMP.
7. Cable shall meet or exceed UL temperature rating of +60 deg C.

C. Primary and Secondary Communications Network Cabling:
1. Cable shall be of type recommended by the DDC system manufacturer.
2. Cable shall be shielded.
3. Cable shall be plenum rated.
4. Cable shall meet or exceed NEC voltage rating of 150 volts.
5. Cable shall meet or exceed UL temperature rating of +60 deg C.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabrication, erection, and installation of the complete mechanical system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. The Contractor shall check all areas and surfaces where mechanical equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the mechanical work.

D. Equipment and systems shall be installed in accordance with manufacturer's instructions, requirements, or recommendations.

3.2 DELIVERY AND STORAGE OF MATERIALS

A. Take provisions for the delivery and safe storage of materials and shall make the required arrangements with other Contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. Contractor shall be responsible for adequately protecting all supplies and equipment during cold weather.

D. All items subject to cold weather damage shall be protected by covering, insulating, or storing in a heated space.

3.3 COOPERATION WITH OTHER CONTRACTORS

A. Perform the work in conformance with the construction called for by other trades and afford other Contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the mechanical work with the work of other Contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the mechanical work which might prevent prompt and proper installation of work required from other trades.

E. Systems Test and Balance Contractors or personnel shall coordinate their work with the contractors who installed the systems being tested or balanced.

F. The Temperature Control Contractor or personnel shall be present during systems test and balance.

3.4 COORDINATION OF WORK

A. The list below is the precedence of assigned work items for space priority in descending order. Items not listed shall have the same precedence as similar items.
   1. Reflected ceiling with all light fixtures, access above light fixtures required for maintenance, sprinkler head locations, and all ceiling fixtures and devices.
   2. Space designed for future utility placement.
   3. Gravity flow plumbing waste, roof drainage, and other systems that rely upon gravity for flow.
   4. Ductwork and appurtenances, except that external bracing shall be relocated to accommodate local interference.
   5. Fire sprinkler piping.
   6. Cable tray with access identification 8 inches horizontal to 6 inches above tray.
   7. Electrical conduit over 2 inches in diameter.
   8. HVAC piping except for pressurized domestic water piping.
   9. Plumbing vents.
   10. Electrical conduit under 2 inches in diameter.

B. Plan all work so it proceeds with a minimum of interference with other trades.

C. It shall also be the responsibility of the Mechanical Contractor to inform the Contractor of all openings required in the building construction for the installation of the mechanical work.

D. The Contractor shall cooperate with all other contractors in furnishing material and information, in proper sequence, for the correct location of all sleeves, inserts, foundations, wiring, etc.

E. Provisions shall be made for all special frames, openings, and sleeves as required.

F. The Contractor shall pay for extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

3.5 ELECTRICAL WIRING

A. Install wiring in accordance with National Electric Code, ANSI/NFPA 70.

B. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable. All wiring running exposed in air plenums shall be plenum cable.

C. Install wiring (low and line voltage) in metal raceways or conduit unless inside control cabinet or unit enclosures.
   1. For concealed and accessible areas, plenum-rated wiring and cabling may be used.

D. Low voltage wiring not installed in conduit shall be supported every five feet from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

E. Low voltage control wiring and 24 VAC can be run in the same conduit. Power wiring 120 VAC and greater must be in a separate conduit.

F. Fastening shall be secured to walls or ceilings by means of appropriate screws, expansion screws anchors, toggle bolts, hollow wall screw anchors, nylon expansion anchors, or expansion shields. All-purpose plastic anchors are not acceptable.

G. Locate circuits, relays, transformers, or other equipment that contains or must be connected to voltages exceeding 130 volts, in separate cabinets, which may be adjacent to control panels; permanently label "DANGER 277 VOLTS" or appropriate volts.

H. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size shall be 3/4 inch.

3.6 CONTROL WIRING AND POWER CONNECTIONS

A. Provide all incidental control power and wiring required to make the equipment or systems fully operational. Coordinate with equipment manufacture incidental wiring requirements.

B. Unless indicted elsewhere, provide line voltage, 120VAC, 20 amp dedicated control power circuits and LAN outlet to each of the following and as indicated:
   1. BMCS Control panel, 1 circuit.
   2. Boiler system, 4 circuits.
   3. Air Terminal Unit Power supply transformer panel, 1 circuit per 20 terminal units.
   4. DDC Power supply and transformer panel. 1 circuit can power 30 terminal units.
   5. Coordinate required 120V power circuits and LAN outlets with Electrical Contractor.

C. Incidental control wiring includes but not limited to:
   1. Air Handling Units:
      a. Fans
      b. Damper Operators
      c. Lights
      d. UVC
      e. Valve Operators
   2. Boiler control system
   3. Electric Duct Heaters
   4. Energy Recovery, Make-up Units and Ventilators
   5. Equipment Motors Starters
   6. Fan Coil Units
   7. Furnaces, Blower Coils, Water Source Heat Pumps, Air to Air Heat Pumps and Condensing Units
      a. Provide 3/4 inch conduit with a minimum of eight distinctively colored or tagged #14 wires between units and remote panels or thermostats for control wiring
   8. HVAC Controls (Including but not limited to):
      a. Manufacturer's Packaged Control Systems
      b. Control Relays
      c. Fan Powered Air Terminal Units
      d. Air Terminal Units
      e. Control Dampers and Valves
      f. Transmitters
   9. Loose Motor Starters
   10. Manual Multi-Speed Switches (Furnished as an Accessory to Mechanical Equipment)
   11. Pushbutton Stations and Emergency Stop Switches
   12. Pumps
   13. Remote Monitoring and Control Panels (Provided by Equipment Manufacturers)
   14. Temporary Heating/Cooling Equipment
   15. Unit Mounted Motor Starters, Contactors, Disconnect Switches, Thermal Overloads and Heaters

16. Variable Frequency Controls.

3.7 LAYING OUT WORK

A. Carefully lay out all work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings, and shop drawings.

B. Equipment layout and all system layouts shall confirm adequate clearances for installation, operation, maintenance, and code-required clearances from the structure or other equipment and systems.

C. Provide offsets and elevation changes in piping, conduit and ductwork as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

D. The layout shall not cause problems of operation, maintenance, or clearance for items installed by other Contractors.

E. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

F. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and shall request clarification.

G. Failure to properly coordinate and lay out the work will require correction by the Contractors at their own expense.

3.8 DATA AND MEASUREMENTS

A. Mechanical and electrical drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and shall adapt their work to actual conditions.

D. Examine the general construction, mechanical, electrical, and other applicable drawings and the Specifications.

E. Only architectural drawings, structural drawings, and site measurements may be utilized in calculations.

F. Layout and coordinate all work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

3.9 POSITION OF DEVICES

A. Locate devices mounted on finished surfaces with regard to paneling, furring, trim, etc. Where several devices occur in a room, they shall be symmetrically arranged as reviewed by the Architect.

B. Devices improperly located or installed shall be repaired, replaced or relocated at the Contractor's expense.

C. Devices shall be set plumb or horizontal and shall extend to the finished surface of the wall, ceiling, or floor without projecting beyond the surface.

D. Devices shown on wood trim, cases, or other fixtures shall be installed symmetrically and, where necessary, shall be set with the long dimension of the plate horizontal.

E. Coordinate their respective devices so as not to destroy the aesthetic effect of the surface in which the devices are mounted.

F. Coordinate the locations of all mechanical items with work furnished by other trades to avoid interference.

G. If the required coordination is not done, the outlets or devices shall be removed and relocated if so directed by the Architect and the damaged surfaces repaired at the Contractor's expense.

H. Devices shall be installed at the height shown below unless otherwise noted. All heights of devices are measured from finished floor to centerline of device.

I. Heights may be adjusted to correspond to nearest masonry course or as necessary to clear wall-mounted cabinets, fin tube convectors, unit heaters, etc.
   1. Temperature control panels: 60 inches
   2. Thermostats: 48 inches
   3. Carbon dioxide (CO2) sensors: 48 inches

3.10 PROTECTION OF APPARATUS

A. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment, and installations from damage of any kind.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.11 ACCESS TO EQUIPMENT

A. All motors, terminal boxes, valves, control devices, specialties, etc., shall be located to provide for easy access for operation, repair and maintenance; if concealed, access doors shall be provided.

B. Access doors required for access to equipment requiring inspection or service shall be provided.

C. Provide all access doors not already furnished by other Contractors but which are required for access to mechanical equipment.

D. Doors shall be 12 inches by 12 inches unless shown otherwise.

E. Person access doors shall be 18 inches by 18 inches minimum.

3.12 ROADWAYS, CURBS, AND WALKS

A. Use every possible precaution to prevent injuries to roadways, curbs, and walks on or adjacent to the site of the work.

B. Any damage shall be repaired at the Contractor's own expense. This shall also include damage necessary for installation of the mechanical work.

3.13 FRAMES

A. Ducts passing through masonry walls shall be installed in steel angle iron frames and sleeves.

B. All sleeves and frames shall be securely fastened to the walls. Provide for structural lintels in masonry wall openings.

C. Ducts passing through openings in poured concrete walls and floors need not have frames.

3.14 FINISHED SURFACES PENETRATIONS

A. All piping and ductwork penetrations of finished surfaces shall have escutcheons and/or closure plates.

B. Openings shall be cut only as large as required for the installation, sleeves, and/or frames installed flush with finished surfaces and grouted in place.

C. Surfaces around openings shall be left smooth and finished to match surrounding surface.

D. Duct frames and pipe sleeves through floors in concealed locations and in unfinished spaces such as mechanical rooms, etc., shall extend 2 inches above finished floor level and shall be caulked watertight.

E. All other sleeves shall extend approximately 1/4 inch above finished floor but shall allow placement of escutcheons.

3.15 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

A. Subject to compliance with the requirements of Division 07.

B. Provide proper sizing when providing sleeves or core-drilled holes to accommodate their work through penetrating items.

C. All voids between sleeve or core-drilled hole and pipe passing through shall be firestopped to meet the requirements of ASTM E814.

D. Install all materials complete, attached securely and permanently in place in accordance with manufacturers' printed directions.

E. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

F. Do not cover installed firestopping until inspected by authority having jurisdiction.

G. Install labeling required by code.

3.16 PIPING AND/OR DUCTWORK SYSTEMS - COMMON REQUIREMENTS

A. General: Install as described below, unless individual Sections specify otherwise. Individual Sections specify unique installation requirements.

B. General Locations and Arrangements:
1. Drawing plans, schematics, and diagrams indicate general, diagrammatic location and arrangement of systems.
2. Indicated locations and arrangements were used to size pipe or ductwork and calculate friction loss, expansion, pump and fan sizing, and other design considerations.
3. Install systems as indicated, unless deviations to layout are approved on Coordination Drawings.
4. Provide offsets and elevation changes in ductwork, piping and conduit as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.
5. Refer to architectural reflected ceiling plans for exact diffuser, register, grille, and ceiling mounted device locations.
6. Do not run ductwork and piping above electrical panels or in code required clearance spaces.
7. Do not run ductwork, piping, and plumbing above or through information technology and data closets, IDF, and MDF rooms. Coordinate all routing with other trades.
8. Coordinate location of ductwork and piping with electrical cable tray. Provide a minimum of 6" of clear access above cable tray for installation of cables.
9. Install all horizontal ductwork and piping in mechanical rooms at a minimum of 7'-6" above finished floor.

10. Install exposed interior and exterior piping and ductwork at right angles or parallel to building walls.
    a. Diagonal runs are prohibited, unless otherwise indicated.
11. Conceal ductwork and piping in walls, pipe chases, utility chases, above ceilings, below grade or floors, unless otherwise noted, except in mechanical rooms or service areas.
12. Install piping and ductwork to allow application of insulation plus 1-inch clearance around insulation.
13. Pipe hangers for insulated pipe with vapor barrier jackets shall be installed around the outside of the insulation and a metal insulation support shield provided to prevent crushing of the insulation.
14. Locate groups of pipes parallel to each other, spaced to permit insulation and valve servicing.
15. Dielectric nipples or flange insulation kits shall be utilized for all dissimilar pipe connections. Dielectric unions will not be accepted.
16. Install piping at indicated slope and as required by code.
17. Provide components with pressure rating equal to or greater than system operating pressure.
18. Install fittings for changes in direction and branch connections.
19. Install piping free of sags or bends with ample space between piping to permit proper insulation applications.
20. Install ductwork and piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building unless otherwise indicated.
    a. Allow sufficient space above ceiling panels to allow for ceiling panel removal.
21. Install ductwork and piping to allow for expansion and contraction without stressing pipe, adjacent building structure or connecting equipment.
    a. Provide expansion loops or compensators where indicated.
22. Do not use ceiling support system to bear weight of devices or systems unless ceiling support system is certified as suitable to do so.
23. During construction, avoid any undue loads, forces or strains on valves, equipment, pumps flanges, or building elements with piping connections or piping systems.
24. Keep all pipe, duct, and equipment openings closed during construction except when actual work is being performed on that item or system.
25. Leaking pipe and duct joints shall be remade using new materials.
26. Roof mounted piping, conduit and ductwork:
    a. Coordinate all roof mounted support locations and loads with roofing contractor.
    b. Space supports per all applicable codes and as indicated.
    c. Provide 18" minimum under pipe, duct and conduit, to allow for roof repair.
27. Piping Penetrations:
    a. Provide pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1) Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
2) Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
3) Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4) Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
5) Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

C. Contractor is responsible for any cutting and patching needed for mechanical installation. Patching must match existing.

D. Size and route refrigerant piping per manufacturers' recommendations.

E. Verify final equipment locations for roughing-in of all systems.

F. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.17 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to manufacturer's requirements and submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components.

E. Connect equipment for ease of disconnecting, with minimum interference to other installations.

F. Install equipment giving right of way to piping installed at required slope.

G. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.18 CONCRETE BASES AND HOUSEKEEPNG PADS

A. Anchor equipment to concrete base or pads according to equipment manufacturer's written instructions and according to applicable seismic codes.

1. Provide bases and pads of dimensions and locations indicated, but not less than 6 inches larger in both directions than supported unit.
2. Use 3000-psi, 28-day compressive-strength concrete.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
8. Bases and pads poured on reinforced concrete slabs shall be a minimu of 4" thick, have 6 x 6 x 10/10 welded wire fabric and shall be doweled to the slab.
9. Self-supporting isolating bases and pads shall be a minimum of 12" thick, have #4 reinforcing bars at 8 inches center to center each way and shall have an expansion joint around the perimeter of the adjoining slab.

3.19 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.20 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
1. Clean surfaces that will come into contact with grout.
2. Provide forms as required for placement of grout.
3. Avoid air entrapment during placing of grout.
4. Place grout, completely filling equipment bases.
5. Place grout on concrete bases to provide smooth bearing surface for equipment.
6. Place grout around anchors.
7. Cure placed grout according to manufacturer's written instructions.

3.21 INCIDENTAL WORK

A. The following incidental work shall be furnished by the designated contractor under the supervision of the Temperature Control Contractor:
1. The Piping Contractor shall install automatic valves and separable wells that are specified to be furnished by the Temperature Control Contractor.
2. The Piping Contractor shall provide all necessary valved pressure taps, water, drain, and overflow connections and piping.

3. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.
4. The Air Distribution Contractor shall install all automatic dampers furnished by the Temperature Control Contractor.
5. The Air Distribution Contractor shall provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
6. The Electrical Contractor shall provide power wiring to the variable frequency drives.
7. The Air Distribution Contractor shall assemble multiple section automatic dampers, furnished by the Temperature Control Contractor, with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper actuators.
8. The Air Distribution Contractor shall provide necessary sheet metal baffle plates to eliminate stratification while providing air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification has been eliminated.
9. The Air Distribution Contractor shall provide access doors or other approved means of access through ducts for service to control equipment.
10. Supply and return air motorized smoke dampers shall be provided by the Air Distribution Contractor on all air handling units 15,000 cfm and larger, as required by NFPA 90A, and shall be controlled by the Temperature Control Contractor. Dampers shall close when fan stops and open when fan starts.

3.22 EQUIPMENT AND SYSTEM SOFTWARE INTERFACES TO THE BMCS

A. Contractor shall coordinate with the BMCS Contractor to determine the points that are to be mapped from the equipment and systems to the BMCS. Contractor shall provide details of the method of integration and the information to be transferred between the systems as part of the submittal package.

B. Contractor shall provide the necessary software communication ports specifically for the interfacing of the systems to the BMCS.

C. Contractor cannot document that the exact same interface has been performed between the selected BMCS and the equipment and/or system, then the interfaces shall be tested prior to installations at an offsite location. The equipment shall not be installed at the project location until all software interfaces to the BMCS have been successfully demonstrated or documented.

D. Documentation regarding the software interfaces shall be provided in sufficient detail as to enable a person reasonably skilled in the writing of real time software applications to add/delete points mapped from one system to the other. The documentation shall include a detailed description of each protocol used and the model, version and firmware details of any protocol converter (gateway) that is used.

E. Refer to BMCS specifications for coordination and testing requirements.

3.23 LUBRICATION, TESTING AND TEST REPORTS

A. Upon completion of the work, the entire system shall be tested and proven for capacity of equipment, balance of system, proper operation of controls, and comfort of conditioned spaces.
   1. Prior to beginning systems testing, adjusting and balancing, replace all filter media with new media.
   2. Test and balance procedures and documentation shall be in accordance with AABC, NEBB, or SMACNA unless indicated otherwise.
   3. Take air and water flow readings and submit copy of same to demonstrate proper flow according to the performances shown on the plans and noted in the specifications.
   4. Motors shall be checked for overload and belts adjusted.
      a. Align pulleys and install belts according to manufacturer's written instructions.
      b. Tension according to manufacturer's written instructions.
   5. Lubricate moving parts and clean or replace filters.
      a. Run in all bearings and, after they are run in, drain and flush bearings and refill with a new oil charge.
      b. Equipment shall be so arranged that tools (screwdrivers, wrenches, etc.) will not be required to make lubrication points accessible.
      c. Extensions on grease or oil fittings shall be provided where required for access to lubricate.
   6. Smoke evacuation systems shall be tested in accordance with the requirements of the authority having jurisdiction and applicable codes and standards.
   7. Test piping systems per applicable codes and standards.
   8. Test ductwork systems per SMACNA and applicable codes and standards.
   9. Submit all test reports to the Architect for review prior to date of substantial completion.
   10. Equipment and systems discrepancies shall be corrected prior to final acceptance.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.2 SUBMITTALS

A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com.

B. Leeson Electric Corporation: www.leeson.com.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com.

D. General Electric

E. U.S. Motors

F. Substitutions: See Section 01 6000 - Product Requirements.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.

B. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.3 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.

C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

D. Single phase motors for pumps and air compressors: Capacitor start type.

E. Single phase motors for fans and blowers: Capacitor start, capacitor run type.

F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.

H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NEMA MG 00001.

J. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

K. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

L. Nominal Efficiency: NEMA MG 1-2006 Premium.

M. Inverter Duty: NEMA MG 1 Part 31.4.4.2.

2.8 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Manufacturers:
1. US Motors, a brand of NIDEC Motor Corporation: www.usmotors.com.
2. _____.

B. Starting Torque: Exceeding one fourth of full load torque.

C. Soft start and soft speed change ramps.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Synchronous rotation. Variable speed direct current brushless. Permanent magnet type. Near zero rotor losses. Permanently lubricated ball bearings. Integrated controller/inverter operates the wound stator and senses rotor position to electronically commutate the stator.

F. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.9 SHAFT GROUNDING

A. Manufacturers:
1. AEGIS SGR
2. Helwig Carbon Products

B. Shaft grounding system for each three-phase AC motor to prevent electrical damage to motor bearings and to extend motor life by safely channeling harmful shaft currents to ground.

C. Provide shaft grounding on all motors controlled by variable frequency controllers and as indicated.

D. Electrographite construction. Integral shunt with quick disconnect terminal and mount.

E. Continuous spring loaded brush holder, conductive carbon brush or carbon fiber ring technology.

F. Replaceable without motor removal or uncoupling..

G. Internal:
1. Integral to motor housing.

H. External:
1. Bolted to motor exterior.
2. Slide ring over the end of the motor shaft and locking it in place with screw on mounting brackets.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

3.2 SCHEDULE

A. NEMA Open Motor Service Factors.
1. 3/4 hp:
   a. 3600 rpm: 1.25.
   b. 1800 rpm: 1.25.
   c. 1200 rpm: 1.15.
   d. 900 rpm: 1.15.
2. 1 hp:
   a. 3600 rpm: 1.25.
   b. 1800 rpm: 1.15.
   c. 1200 rpm: 1.15.
   d. 900 rpm: 1.15.
3. 1.5-150 hp:
   a. 3600 rpm: 1.15.
   b. 1800 rpm: 1.15.
   c. 1200 rpm: 1.15.
   d. 900 rpm: 1.15.

END OF SECTION

SECTION 23 0519

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

C. Test plugs.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.3 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

B. Project Record Documents: Record actual locations of components and instrumentation.

1.4 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Minimum Pressure Rating: 150 psig.

B. Meters and Gages exposed to outdoor enviroment, water spray or wash shall be provided with weatherproofed cases.

2.2 PRESSURE GAUGES

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com.
   2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
   3. Omega Engineering, Inc: www.omega.com.

4. Winters Instruments: www.winters.com/#sle.
5. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
6. Ernst Gage Co.
7. Marsh Bellofram.
8. Miljoco.
9. Trerice, H.O. Co.
10. Weiss Instruments, Inc.
11. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
12. WIKA Instrument Corporation.

B. Pressure Gages: ASME B40.100, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
2. Size: 3-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi.

2.3 PRESSURE GAUGE TAPPINGS

A. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

B. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

2.4 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
4. Winters Instruments: www.winters.com/#sle.
5. Miljoco.
6. Trerice, H.O. Co.
7. Weiss Instruments, Inc.
8. WIKA Instrument Corp.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percentper ASTM E77.
5. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.6 TEST PLUGS

A. Manufacturers:
1. Dwyer Instruments, Inc; _____: www.dwyer-inst.com/#sle.
2. Watts Water Technologies, Inc; _____: www.watts.com/#sle.
3. Weiss Instruments, LLC; _____: www.weissinstruments.com/#sle.
4. Weksler Glass Thermometer Corp; _____: www.wekslerglass.com/#sle.
5. Winters Instruments; _____: www.winters.com/#sle.
6. Peterson Equipment Company.

B. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

C. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.7 FILTER GAGES

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. Omega Engineering, Inc: www.omega.com.
3. Veris Industries: www.veris.com/#sle.
4. Weksler Glass Thermometer Corp: www.wekslerglass.com.

B. 3-1/2 inch diameter dial, for wall mounting, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide a flow straightener upstream of meters, if required to meet the manufacturer’s minimum upstream straight pipe run requirement.

C. Provide lateral and horizontal supports as required to minimize vibration at the meter location.

D. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

E. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples to allow clearance from insulation.

F. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

G. Install thermometer sockets for all thermometers and adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0923.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

K. Locate test plugs adjacent thermometers and thermometer sockets.

3.2 SCHEDULE

A. Pressure Gauges, Location and Scale Range:
1. Pumps, 0 to 200 psi.
2. Pressure reducing valves, 0 to 100 psi.

B. Pressure Gage/Thermometer Tappings (Test Plugs), Location:
1. Major coils - inlets and outlets.
2. Heat exchangers - inlets and outlets.
3. Chiller - inlets and outlets.
4. Boiler - inlets and outlets.
5. Pumps - inlets and outlets.
6. Where shown on drawings or details.

C. Dial and Stem Type and Digital Thermometers, Location and Scale Range:
1. Headers to central equipment, 30 to 240 degrees F.
2. Heating coil banks - inlets and outlets, 30 to 180 degrees F.
3. Cooling coil banks - inlets and outlets, 0 to 120 degrees F.
4. Heat exchangers - inlets and outlets, 30 to 240 degrees F.
5. Boilers - inlets and outlets, 30 to 240 degrees F
6. Chiller - inlets and outlets, 0 to 120 degrees F.
7. Cooling Tower - inlets and outlets, 0 to 120 degrees F.

8. Water zone supply and return, 30 to 240 degrees F.

END OF SECTION

SECTION 23 0523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Angle valves.

B. Globe valves.

C. Ball valves.

D. Butterfly valves.

E. Check valves.

F. Gate valves.

G. Plug valves.

H. Chainwheels.

1.2 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. TFE: Tetrafluoroethylene.

I. WOG: Water, oil, and gas.

1.3 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding.

B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.

H. ASME B31.1 - Power Piping.

I. ASME B31.9 - Building Services Piping.

J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

K. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

M. ASTM A536 - Standard Specification for Ductile Iron Castings.

N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

O. AWWA C606 - Grooved and Shouldered Joints.

P. MSS SP-45 - Drain and Bypass Connections.

Q. MSS SP-67 - Butterfly Valves.

R. MSS SP-68 - High Pressure Butterfly Valves with Offset Design.

S. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.

T. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.

U. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends.

V. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.

W. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

Y. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided.

1.4 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

1.5 QUALITY ASSURANCE

A. Manufacturer:
1. Obtain valves for each valve type from single manufacturer.
2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.

B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
   a. Provide temporary inlet and outlet caps.
   b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
   a. Store valves indoors in dry environment.
   b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. All Valve Types:
1. Crane/Stockham Co.; Crane Valve Group: www.cranevalve.com.
2. Ferguson Enterprises Inc: www.fnw.com/#sle.
3. Hammond Valve: www.hammondvalve.com.
4. Milwaukee Valve Company: www.milwaukeevalve.com.
5. Nibco, Inc: www.nibco.com.
6. Watts: www.watts.com.

B. Gate, Globe and Angle Valves:
1. Apollo Flow Controls: www.appollovalves.com
2. Conbraco Industries: www.apollovalves.com.
3. Tyco Flow Control: www.tycoflowcontrol.com.
4. Powell: www.powellvalves.com.
5. Victaulic Company[<>]: www.victaulic.com.

C. Ball Valves:
1. Apollo Flow Controls: www.appollovalves.com
2. Conbraco Industries: www.apollovalves.com.
3. Grinnell Products, a Tyco Business: www.grinnell.com.
4. Tyco Flow Control: www.tycoflowcontrol.com.
5. Victaulic Company: www.victaulic.com.
6. Viega LLC: www.viega.us/#sle.

D. Plug Valves:
1. Conbraco Industries: www.apollovalves.com.
2. DeZurick: www.dezurick.com.
3. Homestead Valve: www.homesteadvalve.com.
4. Jamesbury Valves: www.jamesbury.com.
5. Nordstrom Valves: www.petrochemvalve.com.
6. Wheatley Valves: www.wheatleyhvac.com.

E. Butterfly Valves:
1. DeZurick: www.dezurick.com.
2. Grinnell Products, a Tyco Business: www.grinnell.com.
3. Keystone Valves: www.keystonevalves.com.
4. Tyco Flow Control: www.tycoflowcontrol.com.
5. Victaulic Company: www.victaulic.com.
6. Wheatley Valves: www.wheatleyhvac.com.

F. Check Valves:
1. Apollo Flow Controls: www.appollovalves.com
2. Grinnell Products, a Tyco Business: www.grinnell.com.
3. Powell: www.powellvalves.com.
4. Tyco Flow Control: www.tycoflowcontrol.com.

5. Victaulic Company: www.victaulic.com.
6. Wheatley Valves: www.wheatleyhvac.com.

2.2 APPLICATIONS

A. See drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on drawings:
1. Throttling (Hydronic): Ball, Globe, and Plug.
2. Throttling (Steam): Gate and Plug.
3. Isolation (Shutoff): Butterfly, Gate, and Ball.
4. Swing Check (Pump Outlet):
   a. Size 2 inch and Smaller: Bronze with bronze disc.
   b. 2-1/2 NPS and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
5. Dead-End: Butterfly, single-flange (lug) type.
6. Provide shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.
7. Provide throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
8. Provide balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
   a. Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be used on equipment where pressure independent control valves are provided.
9. Provide check valves at each pump discharge and elsewhere as required to control flow direction.
10. Provide safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Provide safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
11. Provide pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
12. Provide automatic cold water fill assembly on each separate hydronic system unless hydronic system contains an automatic glycol feed system.

D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

E. Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
   a. Size 2 inch and Smaller: Threaded ends.
   b. 2-1/2 NPS and Larger: Grooved or flanged ends.
2. Copper Tube:
   a. Size 2 inch and Smaller: Threaded ends, except solder-joint valve-ends.

b. 2-1/2 NPS and Larger: Grooved or flanged ends.

3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.

F. Chilled Water Valves:

1. 2 NPS and Smaller, Brass and Bronze Valves:
   a. Threaded ends.
   b. Angle: Bronze disc, Class 125.
   c. Ball: Full port, two piece, brass trim.
   d. Swing Check: Bronze disc, Class.
   e. Gate: NRS, Class 125.
   f. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
   a. 2-1/2 NPS to 4 NPS: Flanged ends.
   b. Ball: 2-1/2 NPS to 10 inch, Class 150.
   c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
   d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
   e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
   f. Butterfly: High performance, single flange, Class 150.
   g. Swing Check: Metal seats, Class 125.
   h. Swing Check with Closure Control: 2-1/2 inch to 12 inch, lever and spring, Class 125.
   i. Grooved-End Check: 3 inch to 12 inch, 300 CWP.
   j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
   k. Plate-Type Check: Single plate, metal seat, Class 125.
   l. Gate: NRS, Class 125.
   m. Globe: Class 125.
   n. Lubricated Plug: Regular gland, threaded, Class 125.

G. Condenser Water Valves:

1. 2 NPS and Smaller, Brass and Bronze Valves:
   a. Threaded ends.
   b. Angle: Bronze disc, Class 125.
   c. Ball: Full port, two piece, brass trim.
   d. Swing Check: Bronze disc, Class 125.
   e. Gate: NRS, Class 125.
   f. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
   a. 2-1/2 NPS to 4 NPS: Flanged ends.
   b. Ball: 2-1/2 inch to 10 inch, Class 150.
   c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
   d. Single-Flange Butterfly: 14 inch to 24 inch, 150 CWP, aluminum-bronze disc, EPDM seat, 150 CWP.
   e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
   f. Butterfly: High performance, single flange, Class 150.

g. Swing Check: Metal seats, Class 125.
h. Swing Check with Closure Control, 2-1/2 inch to 12 inch: Lever and spring, Class 125.
i. Grooved-End Swing Check: 3 inch to 12 inch, 300 CWP.
j. Iron Center-Guided Check: 2-1/2 inch to 24 inch, compact-wafer, metal seat, Class 125.
k. Iron Plate-Type Check: Single plate, metal seat, Class 125.
l. Iron Gate: NRS, Class 125.
m. Iron Globe: 2-1/2 inch to 12 inch, Class 125.
n. Lubricated Plug: Regular gland, Class 125.

H. Heating Hot Water Valves:
1. 2 NPS and Smaller, Brass and Bronze Valves:
a. Threaded ends.
b. Angle: Bronze disc, Class 125.
c. Ball: Full port, two piece, brass trim.
d. Swing Check: Bronze disc, Class 125.
e. Gate: NRS, Class 125.
f. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
a. 2-1/2 NPS to 4 NPS: Flanged ends.
b. Ball: 2-1/2 inch to 10 inch, Class 150.
c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
f. Butterfly: High performance, single flange, Class 150.
g. Swing Check: Metal seats, Class 125.
h. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
i. Grooved-End Swing Check: 3 inch to 12 inch, 300 CWP.
j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
k. Plate-Type Check: Single plate, metal seat, Class 125 .
l. Gate: NRS, Class 125.
m. Globe: 2-1/2 inch to 12 inch, Class 125.

I. Low Pressure Steam Valves for Pressures of 15 psi or Less:
1. 2 NPS and Smaller, Brass and Bronze Valves:
a. Angle: Bronze disc, Class 125.
b. Swing Check: Bronze disc, Class 125.
c. Gate: RS, Class 125.
d. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
a. 2-1/2 NPS to 4 NPS: Flanged ends.
b. Swing Check: Metal seats, Class 125.

c. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure. control, Class 125.
d. Gate: OSY, Class 125.
e. Globe: 2-1/2 inch to 12 inch: Class 125.

J. High Pressure Steam Valves for Pressures Greater than 15 psi:
1. 2 NPS and Smaller, Brass and Bronze Valves:
a. Angle: Bronze disc, Class 125.
b. Swing Check: Bronze disc, Class 125.
c. Gate: RS, Class 125.
d. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
a. 2-1/2 NPS to 4 NPS: Flanged ends.
b. Swing Check: Metal seats, Class 125.
c. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
d. Gate: OSY, Class 125.
e. Globe: 2-1/2 inch to 12 inch, Class 125.

K. Steam-Condensate Valves:
1. 2 NPS and Smaller, Brass and Bronze Valves:
a. Gate: NRS and RS, Class 125.
b. Angle: Bronze disc, Class 150.
c. Globe: Bronze disc, Class 125.
2. Size 2-1/2 inch and Larger, Iron Valves:
a. Provide 2-1/2 NPS to 4 NPS with flanged ends.
b. Swing Check: Metal seats, Class 125.
c. Swing Check: Lever and spring closure control, Class 125.
d. Gate: NRS, Class 125.
e. Globe: 2-1/2 inch to 12 inch, Class 125.
f. Lubricated Plug: Threaded, cylindrical, threaded, Class 125.

2.3 GENERAL REQUIREMENTS

A. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

B. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

C. Valve Sizes: Match upstream piping unless otherwise indicated.

D. Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 inch and larger.

2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 6 NPS and smaller.
4. Wrench: Plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

F. Memory Stops: Fully adjustable after insulation is installed.

G. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

H. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Power Piping Valves: ASME B31.1.
3. Building Services Piping Valves: ASME B31.9.

I. Bronze Valves:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

J. Valve Bypass and Drain Connections: MSS SP-45.

K. Source Limitations: Obtain each valve type from a single manufacturer.

2.4 BRONZE, ANGLE VALVES

A. CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded.
4. Stem: Bronze.
5. Disc: Bronze, PTFE, or TFE.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.5 BRONZE, GLOBE VALVES

A. CWP Rating: Class 125: 200 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded or solder joint.
4. Stem and Disc: Bronze or PTFE.
5. Packing: Asbestos free.
a. Handwheel: Malleable iron.

2.6 IRON, GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:.
1. Comply with MSS SP-85, Type I.
2. Body: Gray iron; ASTM A126, with bolted bonnet.
3. Ends: Flanged.
4. Trim: Bronze.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel or chainwheel.

2.7 BRASS, BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Vacuum Rating: 28.9 in-Hg.
5. Body: Forged brass.
6. Seats: PTFE or TFE.
7. Stem: Stainless Steel.
8. Ball: Stainless steel.
9. Operator: Tee handle and stem extension.

2.8 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze or Brass Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 400 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. End Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze or brass.
8. Ball: Chrome plated brass.

9. Operator: Provide lockable handle and stem extension.

2.9 IRON, GROOVED-END BALL VALVES

A. Class 200:
1. CWP Rating: 600 psi.
2. Body: Ductile iron; ASTM A536, Grade 65-45-12.
3. Ends: Grooved.
4. Seats: Teflon.
5. Stem: Nickel plated carbon steel.
6. Ball: NIckel plated carbon steel or Type 304 stainless steel.

2.10 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer and Lug Style:
1. Comply with MSS SP-67, Type I.
2. Wafer Style, CWP Ratings:
a. Sizes 2 to 12 inches: 200 psi.
b. Sizes 14 to 24 inches: 150 psi.
3. Body Material: {\rs\#1} cast iron or {\rs\#1} ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: NBR.
6. Disc: Aluminum-bronze.
7. Removable Manual Actuator: Lockable handle or worm-gear-connected handwheel with open/close position indication.
8. Service Temperature Range: Minus 30 to 250 degrees F.
9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.11 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type; Bidirectional dead end service without downstream flange:
1. Comply with MSS SP-68.
2. Class 150: CWP Rating: 285 psig at 100 degrees F.
3. Seat: Reinforced PTFE.
4. Offset stem: Stainless steel.
5. Disc: Stainless steel.

2.12 BRONZE, LIFT CHECK VALVES

A. Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psi.
3. Design: Vertical flow.
4. Body: Bronze.
5. Ends: Threaded.
6. Disc (Type 1): Bronze.
7. Disc (Type 2): NBR or PTFE.

2.13 BRONZE, SWING CHECK VALVES

A. Class 125:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WSP Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Bronze.

2.14 IRON, FLANGED END SWING CHECK VALVES

A. Class 125:
1. 150 psi with metal seats.
2. 200 psi with metal seats and nonmetallic-to-metal seats.

2.15 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged.
7. Trim: Bronze.
8. Gasket: Asbestos free.
9. Closer Control: Factory installed, exterior lever, and spring or weight.

2.16 IRON, GROOVED-END SWING CHECK VALVES

A. Class 300:
1. CWP Rating: 300 psi.
2. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM or Nitrile.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

2.17 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Compact-Wafer:
1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Material: ASTM A126, gray iron.
5. Metal Seat: Bronze.

B. Class 125, Globe:

1. Comply with MSS SP-125.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
4. Body Material: ASTM A126, gray iron.
5. Style: Spring loaded.
6. Ends: Flanged.
7. Metal Seat: Bronze.

2.18 IRON, PLATE-TYPE CHECK VALVES

A. Class 125 Single-Plate:
1. Comply with API STD 594.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Body Design: Wafer, spring-loaded plate.
4. Body Material: ASTM A126, gray iron.
5. Resilient Seat: EPDM or NBR.

B. Class 125 Dual-Plate:
1. Comply with API STD 594.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Body Design: Wafer, spring-loaded plates.
4. Body Material: ASTM A126, gray iron.
5. Resilient Seat: EPDM or NBR.

2.19 BRONZE, GATE VALVES

A. Non-Rising Stem (NRS) or Rising Stem (RS):
1. Comply with MSS SP-80, Type I.
2. Class 125: CWP Rating; 200 psi.
3. Body Material: Bronze with integral seat and union-ring bonnet.
4. Ends: Threadedor solder joint.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

2.20 IRON, GATE VALVES

A. NRS or OS & Y:
1. Comply with MSS SP-70, Type I.
2. Class 125:
   a. Sizes 2-1/2 to 12 inch, CWP Rating; 200 psi.
   b. Sizes 14 to 24 inch, CWP Rating; 500 psi.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

2.21 LUBRICATED PLUG VALVES

A. Regular Gland and Cylindrical with Flanged Ends:
   1. Comply with MSS SP-78, Type II.
   2. Class 150:
      a. Sizes 2-1/2 to 12 inch , CWP Rating; 200 psi.
      b. Sizes 14 to 24 inch, CWP Rating; 150 psi.
   3. Body Material: Cast iron with lubrication sealing system.
   4. Pattern: Regular or short.
   5. Plug: Cast iron or bronze with sealant groove.

2.22 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to ball, butterfly, plug, and gate valve stems.
   3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
   4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.

3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 inches or more above finished floor, terminating 60 inches above finished floor.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components.

1.2 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

K. FM (AG) - FM Approval Guide.

L. MFMA-4 - Metal Framing Standards Publication.

M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

N. UL (DIR) - Online Certifications Directory.

O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

A. Comply with applicable building code.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of mechanical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Prefabricated Trapeze-Framed Metal Strut Systems:
1. Strut Channel or Bracket Material:

a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

2. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Piping up to 1 inch: 1/4 inch diameter.
c. Piping larger than 1 inch: 3/8 inch diameter.
d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Steel Cable:
1. Manufacturers:
a. Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
b. Elgen Manufacturing Company, Inc: www.elgenmfg.com.

E. Cable Hanging System Kits:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/.
b. Ductmate Industries, Inc: ductmate.com.
c. Gripple, Inc: www.gripple.com.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide cable-wire in bulk or precut lengths with respective cable hangers as required to hold minimum weight of 120 lb.
3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.

F. Thermal Insulated Pipe Supports:
1. General Requirements:
a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
b. Minimum Service Temperature: Minus 40 degrees F.
c. Maximum Service Temperature: 180 degrees F.

d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
e. Thickness: 60 mil.

G. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up To 122 degrees F:
a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
b. Support From Below: MSS SP-58 Types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.

H. Pipe Stanchions:
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

I. Beam Clamps:
1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

J. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

K. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

L. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.

M. Insulation Clamps:
1. Two bolt-type clamps designed for installation under insulation.
2. Material: Carbon steel with epoxy copper or zinc finish.

N. Pipe Hangers:

O. Intermediate Pipe Guides:
1. Pipe Diameter 6 inch and Smaller: Provide minimum clearance of 0.16 inch.
2. Pipe Sizes 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
3. Pipe Size 10 inch: 0.75 inch U-bolt.
4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
5. Pipe Sizes 18 to 30 inch: 1 inch U-bolt.
6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

P. Pipe Alignment Guides:
1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
2. Pipe Sizes 10 inch and Larger: Roller type.

Q. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

R. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

S. Pipe Shields for Insulated Piping:
1. General Construction and Requirements:
    a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    b. Shields Material: UV-resistant polypropylene with glass fill.
    c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    d. Minimum Service Temperature: Minus 40 degrees F.
    e. Maximum Service Temperature: 178 degrees F.

f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

T. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Powder-actuated fasteners are not permitted.
   a. Use only threaded studs; do not use pins.
10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
11. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   a. Install and support non-metalic pipe and tubing in accordance with manufacturer's instructions.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
    a. Where trapeze hangers are constructed, the threaded rods supporting the trapeze member shall not extend more than 1" below assembly.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Steel Pipe Saddles:
    a. Provide on all heating hot water piping, operating above 200 degrees F, 3" and larger.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

I. Where trapeze hangers are constructed, the threaded rods supporting the trapeze member shall not extend more than 1" below assembly.

J. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

K. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

L. Secure fasteners according to manufacturer's recommended torque settings.

M. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.2 SUBMITTALS

A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Stencilled painting.

C. Control Panels: Nameplates.

D. Dampers: Ceiling grid markers, where located above lay-in ceiling.

E. Heat Transfer Equipment: Nameplates.

F. Piping: Pipe markers.

G. Pumps: Nameplates.

H. Relays: Tags.

I. Small-sized Equipment: Tags.

J. Tanks: Nameplates.

K. Valves: Tags and ceiling grid markers where located above lay-in ceiling.

L. Water Treatment Devices: Nameplates.

2.2 MANUFACTURERS

A. Advanced Graphic Engraving: www.advancedgraphicengraving.com.

B. Brady Corporation: www.bradycorp.com.

C. Brimar Industries, Inc.: www.pipemarker.com.

D. Champion America, Inc: www.Champion-America.com.

E. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

F. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.

G. Seton Identification Products: www.seton.com/aec.

2.3 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Comply with ASTM D709.

2.4 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch octagonal.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch octagonal with smooth edges.

C. Valve Tag Schedule: In Valve and Equipment Binder.

2.5 PIPE MARKERS

A. Color: Comply with Metro Facility Standards (posted in Mechanical Room) and ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

E. Metro Transit Facility Color Code (posted in Mech Rm) as follows:
1. Heating Hot Water: Orange with black letters.
2. Exhaust and Vent Lines: Brown with black letters.
3. Chilled Water: Green with black letters
4. Natural Gas: Yellow with black letters.
5. Fuel Oil: Gray with black letters.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.
1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify air terminal units stencilled painting and valves with numbered tags.

K. Locate ceiling grid markers to locate valves above T-bar type panel ceilings. Locate on grid closest to equipment.

3.3 TAGS

A. Install tags with corrosion-resistant chain.

B. Identify valves in main and branch piping with tags.

C. Identify air terminal units coil valves with numbered tags.

D. Tag automatic controls, instruments, and relays. Keep to control schematic.

E. Identify small devices such as in-line pumps with tags.

F. Identify pipe 1 inch and smaller with tags.

3.4 PIPE MARKERS

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install plastic tape pipe markers complete/around pipe in accordance with manufacturer's instructions.

C. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure and at each obstruction.

D. All underground piping systems shall have a non-metallic warning tape, with appropriate warning, buried 24 inches above top of pipe.

3.5 NAME PLATES

A. Install plastic name plates with stainless steel screws.

B. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.

C. Identify control panels and major control components outside panels with plastic nameplates.

3.6 VALVE AND EQUIPMENT SCHEDULE BINDER

A. Provide 3-ring binder for all valve and equipment schedules with tabs and plastic page protectors for each system. Schedules to be on standard - size bond paper with following information:
   1. Valve Schedules:
      a. Valve number

b. Piping system
c. System abbreviation (as shown on valve tag)
d. Location of valve (room or space)
e. Area served
f. Normal operating position (opened, closed, modulating)
g. Indicate emergency shutoff or similar special uses.

2. As-Built Record Building Plans:
a. Indicate all valve and equipment locations
b. Provide in electronic format, .pdf or .dwg

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems and components.

B. Testing, adjustment, and balancing of hydronic systems and components.

C. Measurement of final operating condition of HVAC systems.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

E. TABB - Testing, Adjusting, and Balancing Bureau.

1.4 SUBMITTALS

A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   3. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified below and in Part 3.
   4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   5. Include at least the following in the plan:
      a. Preface: An explanation of the intended use of the control system.
      b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

d. Identification and types of measurement instruments to be used and their most recent calibration date.
e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
f. Final test report forms to be used.
g. Detailed step-by-step procedures for TAB work for each system and issue, including:
    1) Terminal flow calibration (for each terminal type).
    2) Diffuser proportioning.
    3) Branch/submain proportioning.
    4) Total flow calculations.
    5) Rechecking.
    6) Diversity issues.
h. Expected problems and solutions, etc.
i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
j. Details of how TOTAL flow will be determined; for example:
    1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
n. Method of checking building static and exhaust fan and/or relief damper capacity.
o. Proposed selection points for sound measurements and sound measurement methods.
p. Methods for making coil or other system plant capacity measurements, if specified.
q. Time schedule for TAB work to be done in phases (by floor, etc.).
r. Description of TAB work for areas to be built out later, if any.
s. Time schedule for deferred or seasonal TAB work, if specified.
t. False loading of systems to complete TAB work, if specified.
u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
v. Interstitial cavity differential pressure measurements and calculations, if specified.
w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
x. Procedures for formal progress reports, including scope and frequency.
y. Procedures for formal deficiency reports, including scope, frequency and distribution.

B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
   3. Provide reports in electronic, word searchable, .pdf format binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
   4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   6. Units of Measure: Report data in I-P (inch-pound) units only.
   7. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name.
      e. Project location.
      f. Project Architect.
      g. Project Engineer.
      h. Project Contractor.
      i. Project altitude.
      j. Report date.
      k. Certification sheet signed and sealed by the certified testing and balancing engineer.

C. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

D. Project Record Documents: Record actual locations of flow measuring stations, balancing dampers, balancing valves and rough setting, balancing dampers, and balancing dampers.

E. As-Balanced Record Pump and Fan Curves: Record actual balanced points on the manufacture's submitted pump and fan curves.
   1. Record system curves and actual RPM data for all fans.
   2. Record system curves, actual RPM and final impeller diameter for all pumps.

F. Final Report Contents: In addition to certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

1.5 PROJECT CONDITIONS

A. The entire TAB process shall be completed prior to Owner Occupancy.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS

2.1 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. SMACNA (TAB).
3. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.
   16. Balancing dampers and devices are installed.
   17. Pressure/Temperature test fittings are installed on each pump.

B. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC

equipment when installed under conditions different from those presented when the equipment was performance tested at the factory.

C. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

D. Examine system and equipment test reports.

E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

G. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

I. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

J. Examine strainers for clean screens and proper perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature control and building automation system components to verify the following:
   1. Check the sequence of operation of control devices are according to the Contract Documents..
   2. Dampers, valves, and other controlled devices are operated by the intended controller.
   3. Dampers and valves are in the position indicated by the controller.

4. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
5. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
6. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
7. Sensors are located to sense only the intended conditions.
8. Controller set points are set at indicated values. Controllers are calibrated and commissioned. Record controller settings and note variances between set points and actual measurements.
9. Changeover from heating to cooling mode occurs according to indicated values.
10. Transmitter and controller locations and note conditions that would adversely affect control functions.
11. Operation of limiting controllers (i.e., high- and low-temperature controllers).
12. Free travel and proper operation of control devices such as damper and valve operators.
13. Interaction of electrically operated switch transducers.
14. Interaction of interlock and lockout systems.
15. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
16. Note operation of electric actuators using spring return for proper fail-safe operations.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

Q. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply and return systems.

B. Outdoor and Exhaust Systems: Minimum shown on documents to plus 10 percent.

C. Air Outlets and Inlets: Adjust individual devices to within plus 10 percent and minus 5 percent of design to space.

D. Kitchen hood supply and exhaust: Minus 5 percent to plus 5 percent. Exhaust airflow shall exceed supply airflow.

E. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems-Testing, Adjusting, and Balancing", and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.6 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.7 AIR SYSTEM PROCEDURE

A. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

B. Check dampers for proper position to achieve desired airflow path.

C. Check for airflow blockages.

D. Check condensate drains for proper connections and functioning.

E. Check for proper sealing of air-handling unit components.

F. Check for proper sealing of air duct system.

G. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

H. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

I. Measure air quantities at air inlets and outlets.

J. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

K. Adjusting:
   1. After installation, adjust diffusers, registers, and grilles to air patterns indicated, as directed and as required to prevent drafts before starting air balancing.
   2. Adjust air patterns per manufactures recommendations based on installed conditions.

L. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

M. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

N. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

O. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

P. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

Q. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

R. On electric heating coils, adjust system to provide required minimum airflow or downstream pressure differential to activate controls.

S. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

T. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

U. Adjust water systems to provide required or design quantities.

V. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

W. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

X. Effect system balance with automatic control valves fully open to heat transfer elements.

Y. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

Z. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

AA. Set calibrated balancing valves, if installed, at calculated presettings.

BB. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

CC. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

DD. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

EE. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

FF. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

GG. Balance variable volume systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.8 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.9 SCOPE

A. Test, adjust, and balance the following:
1. Plumbing Pumps.
2. HVAC Pumps.
3. Air Coils.
4. Terminal Heat Transfer Units.
5. Fans.
6. Air Inlets and Outlets.

3.10 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.
   9. Motors Driven by Variable-Frequency Controllers:
      a. Test for proper operation at speeds varying from minimum to maximum.
      b. Test the manual bypass for the controller to prove proper operation.
      c. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

B. V-Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Driven sheave, diameter and RPM.
   4. Belt, size and quantity.
   5. Motor sheave diameter and RPM.
   6. Center to center distance, maximum, minimum, and actual.

C. Pumps:
   1. Identification/number.
   2. Manufacturer.
   3. Size/model.
   4. Impeller.
   5. Service.
   6. Design flow rate, pressure drop, BHP.
   7. Actual flow rate, pressure drop, BHP.
   8. Discharge pressure.
   9. Suction pressure.
   10. Total operating head pressure.
   11. Shut off, discharge and suction pressures.
   12. Shut off, total head pressure.

D. Combustion Equipment:
   1. Boiler manufacturer.
   2. Model number.
   3. Serial number.
   4. Firing rate.
   5. Overfire draft.
   6. Gas meter timing dial size.
   7. Gas meter time per revolution.
   8. Gas pressure at meter outlet.

9. Gas flow rate.
10. Heat input.
11. Burner manifold gas pressure.
12. Percent carbon monoxide (CO).
13. Percent carbon dioxide (CO2).
14. Percent oxygen (O2).
15. Percent excess air.
16. Flue gas temperature at outlet.
17. Ambient temperature.
18. Net stack temperature.
19. Percent stack loss.
20. Percent combustion efficiency.
21. Heat output.

E. Electric Duct Heaters:
1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

F. Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

G. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.

8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

H. Air Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

I. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

J. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 ADDITIONAL TESTS AND INSPECTIONS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions. Make a total of three (3) inspections after occupancy of building to insure that satisfactory conditions are being maintained throughout and to satisfy any unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

C. Make an inspection in building during opposite season in which initial adjustments were made, and at that time make any necessary modifications to initial adjustment required to produce optimum operation of system components to produce proper conditions in each conditioned space. At time of opposite season checkout, Owner's representative shall be timely notified before any readings or adjustments.

END OF SECTION

SECTION 23 0713

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

1.2 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations. Show details for application of field-applied jackets.

B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of experience and approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density, thickness, and appropriate ASTM standard designation.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

B. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

C. Insulation products shall not contain asbestos, lead, mercury, mercury compounds, or formaldehyde.

D. Products shall be certified by UL GREENGUARD GOLD or Indoor Advantage Gold.

E. Products shall certified to meet or exceed UL Standard 2818 -2013 Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings

F. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

G. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation; : www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Manson Insulation, Inc.: www.mansoninsulation.com
5. Owens Corning Corp; : www.owenscorning.com.

B. Vapor Barrier Tape:
1. Aluminized foil film, with pressure sensitive acrylic based adhesive, 3 inches wide, 6.5 mils thick, 58-ounce force/inch adhesion, 23 lbf/inch tensile strength. Service temperature -40 - 250 degree F.

2.3 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation; : www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Manson Insulation, Inc.: www.mansoninsulation.com
5. Owens Corning Corporation: www.ocbuildingspec.com.

2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc: www.aeroflexusa.com.
2. Armacell LLC: www.armacell.us.
3. K-Flex USA LLC: www.kflexusa.com.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.5 FIRE-RATED INSULATION SYSTEMS

A. Manufacturer:
1. 3M; Fire Barrier Wrap Products.
2. CertainTeed Corporation; [<>]: www.certainteed.com.
3. Johns Manville Corporation; [<>]: www.jm.com.
4. Knauf Insulation; : www.knaufusa.com.
5. Manson Insulation, Inc.: www.mansoninsulation.com
6. Nelson Firestop Products.
7. Owens Corning Corp; : www.owenscorning.com.
8. Thermal Ceramics;
9. Unifrax Corporation;
10. Vesuvius;

B. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 degrees F. Comply with ASTM C 656, Type II, Grade 6. UL tested and certified to provide a 1-hour fire rating.

C. Fire-Rated Blanket: FSK-encapsulated blanket consisting of alumino-silicate, refractory ceramic fibers (RCF) or alkaline-earth silicate wools (CMS), 8 pounds per cubic foot and shall meet the requirements of NFPA 96, UL 1978, 1479, and ASTM E119, certified to provide 1-hour rating.

2.6 DUCT LINER

A. Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com.
2. Armacell LLC: www.armacell.us.
3. CertainTeed Corporation: www.certainteed.com.
4. Ductmate Industries, Inc, a DMI Company: www.ductmate.com.
5. Johns Manville: www.jm.com.
6. Owens Corning Corporation: www.ocbuildingspec.com.
7. RBX Corporation.

B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Fungal Resistance: No growth when tested according to ASTM G21.
   4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
   5. Minimum Noise Reduction Coefficients:
      a. 1/2 inch Thickness: 0.30.
      b. 1 inch Thickness: 0.40.
      c. 1-1/2 inches Thickness: 0.50.
      d. 2 inch Thickness: 0.60.
   6. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm when tested in accordance with ASTM C1071.
   7. Connection: Waterproof vapor barrier adhesive.
   8. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.

C. Polyester Fiber Insulation:
   1. Insulation: Non-corrosive, incombustible, thermally bonded, polyester fiber complying with ASTM C1071; rigid board; impregnated surface with FSK facing and edges coated water based coating.
      a. Thickness: 1 inch.
      b. Zero VOCs: ASTM D5116.
      c. Fungi Resistance: ASTM G21.
      d. Apparent Thermal Conductivity: Maximum of .24 at 75 degrees F.
      e. Service Temperature: Up to 250 degrees F.
      f. Rated Velocity on Coated Air Side for Air Erosion: 4000 fpm, minimum.
      g. Minimum Noise Reduction Coefficients:
         1) 1/2 inch Thickness: 0.30.
         2) 1 inch Thickness: 0.45.
         3) 1-1/2 inches Thickness: 0.60.
         4) 2 inch Thickness: 0.70.
   2. Adhesive: Waterproof, fire-retardant type, ASTM C916.
   3. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:

1. Provide insulation with vapor barrier jackets, with minimum installed R-value of 6.0.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket, with minimum installed R-value of 6.0.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
6. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
    a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
    b. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
    c. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
        1) On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
        2) On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
        3) Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
        4) Do not overcompress insulation during installation.
        5) Impale insulation over pins and attach speed washers.
        6) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

d. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor barrier mastic, and sealant at joints, seams, and protrusions.
   1) Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
   2) Install vapor stops for ductwork and plenums operating below 50 degrees F at 18-foot intervals. Vapor stops shall consist of vapor barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness but not less than 3 inches.

e. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

f. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.

g. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

7. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   b. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transition.
   c. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      1) On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      2) On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      3) Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      4) Do not overcompress insulation during installation.
      5) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

d. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor barrier mastic, and sealant at joints, seams, and protrusions.
   1) Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seals.
   2) Install vapor stops for ductwork and plenums operating below 50 degrees F at 18-foot intervals. Vapor stops shall consist of vapor barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness but not less than 3 inches.

e. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

f. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.
6. Lined ducts shall be fabricated to provide the net inside dimensions shown.
7. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
8. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
9. Butt transverse joints without gaps and coat joint with adhesive.
10. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
11. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
12. Apply adhesive coating on all longitudinal seams.
13. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

14. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.3 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating in accordance with manufacturer's recommendations.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies.

3.4 DUCT INSULATION

A. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

B. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

C. Items Not Insulated:
1. Fibrous-glass ducts.
2. Metal ducts and plenums with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.5 INSULATION AND JACKET SCHEDULE

A. Duct Liner
1. Duct liner shall not be used on the following locations:
a. Ahead of any coil on all air distribution systems.
b. Within 20 feet downstream of a humidifier.
c. In any supply air duct system which serves laboratory spaces or any other area having special concerns for dust or airborne contaminants.
2. Transfer Ducts, Sound Traps and Boots and as indicated: 1-inch liner.
3. Fan Coil Units:
a. Supply Air: 1-inch liner 5 feet downstream.
4. Terminal Units:
a. Supply Air: 1-inch liner 5 feet downstream.

5. Air Handling Units:
   a. Supply Air: 2-inch liner 5 feet downstream, including one elbow.
   b. Return Air: 2-inch liner 5 feet upstream, including one elbow.
6. Rooftop Units:
   a. Supply Air: 2-inch liner 5 feet downstream, including one elbow.
   b. Return Air: 2-inch liner 5 feet upstream, including one elbow.

B. Indoor Duct and Plenum
   1. Supply Air:
      a. Concealed, supply-air duct insulation shall be any of the following:
         1) Glass-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
         2) Glass-Fiber Blanket: 2.2 inches thick and 0.75-lb/cu. ft. nominal density.
      b. Concealed, supply-air plenum insulation shall be any of the following:
         1) Flexible Elastomeric: 1 inch thick.
      c. Exposed in Finished Space, rectangular, supply-air duct insulation shall be any of the following:
         1) Duct Liner: 1 inch thick.
      d. Exposed in Finished Space, round or flat oval, supply-air duct insulation shall be any of the following:
         1) Duct Liner: 1 inch thick or double wall insulated duct as indicated.
      e. Exposed in mechanical room, rectangular, supply-air duct insulation shall be any of the following:
         1) Glass-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
      f. Exposed in mechanical room, round or flat oval, supply-air duct insulation shall be any of the following:
         1) Glass-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
         2) Glass-Fiber Blanket: 2.2 inches thick and 0.75-lb/cu. ft. nominal density.
      g. Exposed in mechanical room, supply-air plenum shall be any of the following:
         1) Glass-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
      h. Supply Diffuser Plenums and Back Panels (Including Linear type):
         1) Glass-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
         2) Glass-Fiber Blanket: 2.2 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Return Air:
      a. None.
   3. Outdoor Air:
      a. Concealed, outdoor-air duct insulation shall be any of the following:
         1) Glass-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft. nominal density.

b. Concealed, outdoor-air plenum insulation shall be any of the following:
   1) Glass-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft. nominal density.

c. Exposed, round and flat-oval, outdoor-air duct insulation shall be any of the following:
   1) Glass-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft.nominal density.

d. Exposed, rectangular, outdoor-air duct insulation shall be any of the following:
   1) Glass-Fiber Blanket: 3 inchesthick and 1.5-lb/cu. ft.nominal density.

e. Exposed in mechanical room, rectangular, outdoor-air duct insulation shall be any of the following:
   1) Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

f. Exposed in mechanical room, outdoor-air plenum shall be any of the following:
   1) Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

g. Exposed in mechanical room, round and flat oval, outdoor-air duct insulation shall be any of the following:
   1) Glass-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft.nominal density.

4. Exhaust Air:
   a. Exhaust and Relief Ducts for a Distance of 36 Inches from Outside Wall/Roof:
      1) Glass fiber blanket, 1-1/2 inches thick nominal density.

END OF SECTION

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

1.2 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.5 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

F. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

2.2 GLASS FIBER, RIGID

A. Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/sle.
5. Manson Insulation.

B. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.
1. Shall meet ASTM C916 Type I/II

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd min. weight.
2. Blanket: 1.0 pcf density.
3. Weave: 5 by 5.

G. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd min. weight.
2. Vinyl emulsion type acrylic, compatible with insulation, white color.
3. Permeance shall be 0.07 perms or less at 45 mils dry tested by ASTM E96.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com.
2. Armacell International; Armaflex: www.armacell.com.
3. K-Flex USA LLC: www.kflexusa.com.
4. RBX Corp.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.

1. K Value: 0.25 at 75 degrees F.
2. Minimum Service Temperature: Minus 40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Moisture Vapor Permeability: .03 perm inch.
5. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 ACCESSORIES

A. General Requirements:
1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

I. Inserts and Shields:
   1. Application: Insulated piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Shield shall span an arc of 180 degrees.
   4. Match diameter of shield to OD of insulation.
   5. Shield dimensions shall not be less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   6. Insert location: Between support shield and piping and under the finish jacket.
   7. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   8. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
   9. Steel Pipe Saddles:
      a. Provide on all steam and steam condensate piping 3" and larger.
      b. Provide on all heating hot water piping, operating above 200 degrees F, 3" and larger.
   10. Thermal-Hanger Shield Inserts: Install according to manufacturer's written instructions.

J. Insulated Piping: Attach hangers and supports to piping as follows:
   1. Piping Operating Above Ambient Temperature:
      a. Where piping is not supported on rollers or trapeze, hangers may project through insulation.
      b. For straight runs of piping, at points of support more than 100 feet from elbow or anchor point, use roller type supports.
      c. Where piping is supported on rollers or trapeze, support piping at outside diameter of insulation.
         1) NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
         2) NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.
   2. Piping Operating Below Ambient Temperature: Support piping at outside diameter of insulation. Do not penetrate vapor barrier.
      a. NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
      b. NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.

K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

3.3 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to

and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
   4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.4 INSULATION AND JACKET SCHEDULE

A. Insulation thickness listed below is based on the thermal conductivity performance of the material listed.
   1. Alternative material thickness must be adjusted as required to provide equivalent conductivity performance.
   2. Alternative material subtitution shall be reviewed by the Architect.

B. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

C. Indoor Piping:
   1. Chilled Water and Brine, Above 40 Degrees F:
      a. 1-1/4 Inches and Smaller:
         1) Glass Fiber, Preformed Pipe, Type I: 1 inch thick.
      b. 1-1/2 Inches and Larger:
         1) Glass Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
   2. Heating Hot Water/Glycol Supply and Return, 200 Degrees F and below:
      a. 1-1/4 Inches and Smaller:
         1) Glass Fiber, Preformed Pipe, Type I: 1 1/2 inches thick.
      b. 1-1/2 Inches and Larger:
         1) Glass Fiber, Preformed Pipe, Type I: 2 inches thick.
   3. Condensate and Equipment Drain Water Below 60 Degrees F:
      a. All Pipe Sizes:

1) Glass-Fiber, Preformed Pipe, Type I: 1/2 inch thick.

END OF SECTION

SECTION 23 0800

COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SUMMARY

A. HVAC system shall be Commissioned as required by all applicable building and energy codes.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Provider (CxP) / (CxA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The following HVAC equipment is to be commissioned, including commissioning activities for the following specific items:
1. Building Management Control System.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Terminal units.
6. Variable frequency drives.
7. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 SUBMITTALS

A. Updated Submittals: Keep Commisioning Provider (CxP) informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
a. Process of verifying proper hardware and wiring installation.
b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
2. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with CxP and TAB contractor for this determination.

B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Provider.

C. Building Management Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
   1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
   2. Full as-built set of control drawings.
   3. Full as-built sequence of operations for each piece of equipment.
   4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
      a. Floor.
      b. Room number.
      c. Room name.
      d. Air handler unit ID.
      e. Reference drawing number.
      f. Air terminal unit tag ID.
      g. Heating and/or cooling valve tag ID.
      h. Minimum air flow rate.
      i. Maximum air flow rate.
   5. Full print out of all schedules and set points after testing and acceptance of the system.
   6. Full as-built print out of software program.
   7. Electronic copy on disk of the entire program for this facility.
   8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
   9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
   10. Control equipment component submittals, parts lists, etc.
   11. Warranty requirements.
   12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
   13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
      a. Sequences of operation.
      b. Control drawings.
      c. Points lists.
      d. Controller and/or module data.
      e. Thermostats and timers.
      f. Sensors and DP switches.
      g. Valves and valve actuators.
      h. Dampers and damper actuators.
      i. Program setups (software program printouts).

D. Project Record Documents: See Section 01 7800 for additional requirements.
   1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.

2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

E. Draft Training Plan: In addition to requirements specified in Section 01 7900, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

F. Training Manuals: See Section 01 7900 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

A. Cooperate with CxP in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by CxP.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by CxP; update the schedule as appropriate.

D. Notify CxP when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction, notify ahead of time and be proactive in seeing that CxP has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with Contract Documents.
   1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

3.2 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by CxP for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
   4. Command valve/damper open; verify position is full open and adjust output signal as required.
   5. Command valve/damper to a few intermediate positions.
   6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

E. Isolation Valve or System Valve Leak Check: For valves not by coils.
   1. With full pressure in the system, command valve closed.
   2. Use an ultra-sonic flow meter to detect flow or leakage.

F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.3 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Prefunctional Checklists, calibrations, startup, and component Functional Tests of the system completed and approved by CxP prior to starting TAB.

F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.4 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by CxP.

D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
   1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
   2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to CxP during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.

G. Demonstrate to CxP:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
   6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
   7. Power failure and battery backup and power-up restart functions.
   8. Global commands features.
   9. Security and access codes.

10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. “After hours” use tracking and billing.
14. Communications to remote sites.
15. Fire alarm interlocks and response.
16. Fire protection and suppression systems interfaces.
17. Security system interlocks.
18. That points that are monitored only, having no control function, are reporting properly to the control system.
19. All control strategies and sequences not tested during controlled equipment testing.
20. Trend logging and graphing features that are specified.
21. Other integrated tests specified in Contract Documents
22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system, for minimum period of 5 days including one weekend, if the control points are monitored by the control system:
1. Duty cycling, if specified.
2. Demand limiting, including over-ride of limiting.
3. Sequential staging ON of equipment; optionally demonstrate manually.
4. Optimum start-stop functions.
5. Miscellaneous equipment current or status for duty cycling and demand limiting.
6. Equipment or building kW or current for demand limiting.
7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 7800 for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Provider for review; make changes recommended by Commissioning Provider.

D. Commissioning Provider will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

A. See Section 01 7900 for additional requirements.

B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to CxP during Functional Testing.

D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
   1. Building Management Control System: 8 hours.
   2. Boilers and System: 2 hours.
   3. Piping Systems: 1 hours.
   4. Chemical Treatment: 1 hours.
   5. Variable Speed Drives: 2 hours.
   6. Air Terminal Units: 1 hours.

E. TAB Review: Instruct Owner's personnel for minimum 4 hours, after completion of TAB, on the following:
   1. Review final TAB report, explaining the layout and meanings of each data type.
   2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   5. Other salient information that may be useful for facility operations, relative to TAB.

F. Building Management Control System Training: Perform training in at least three phases:
   1. Phase 1 - Basic Control System: Provide minimum of 8 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
      a. This training may be held on-site or at the manufacturer's facility.
      b. If held off-site, the training may occur prior to final completion of the system installation.
      c. For off-site training, Contractor shall pay expenses of up to two attendees.
   2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 8 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:

a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
d. Every display screen, allowing time for questions.
e. Use of keypad or plug-in laptop computer at the zone level.
f. Use of remote access to the system via phone lines or networks.
g. Setting up and changing an air terminal unit controller.
h. Graphics generation.
i. Point database entry and modifications.
j. Understanding DDC field panel operating programming, when applicable.

3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 2 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.

H. Provide the services of the Building Management Control System instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 0913.13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control panels.

B. Unitary Controllers

C. Power Supplies and Transformers.

D. Low Voltage Control Cable.

E. Control Valves:
   1. Globe pattern.
   2. Butterfly pattern.

F. Control Dampers.

G. Input/Output Sensors:
   1. Temperature sensors.
   2. Static pressure (air pressure) sensors.
   3. Equipment operation (current) sensors.

H. Thermostats:
   1. Outdoor reset thermostats.
   2. Immersion thermostats.
   3. Electric low limit duct thermostats.
   4. Electric high limit duct thermostats.

I. Transmitters:
   1. Building static pressure transmitters.
   2. Air pressure transmitters.
   3. Water pressure transmitters (liquid differential pressure transmitters).
   4. Thermowells.

J. Output Devices.

K. Flow Sensors:
   1. Insertion turbine meters.
   2. Insertion magnetic flow meters.

1.2 REFERENCE STANDARDS

A. ANSI/FCI 70-2 - Control Valve Seat Leakage.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. UL 555S - Standard for Smoke Dampers.

E. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

F. UL 555 - Standard for Fire Dampers.

G. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.3 SUBMITTALS

A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
   1. Manufacturer's printed data sheets for all control system components clearly identify data by component.
   2. General catalog sheets, including details of construction, ratings, and dimensions for each component.

B. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
   1. Show complete details of interconnections between temperature control systems and control specified with equipment or systems.
   2. Provide valve schedules indicating size, type, design flow, valve capacity, pressure drop and CV value, identification, and part number.
   3. Provide dampers schedule indicating dimension and descriptions of blank-offs, installation location, arrangement, velocities, static pressure drop, damper features, identification, and part number.
   4. Control panel locations indicated on plans.
   5. Control panel interior layout drawings indicating the following:
      a. Overall panel size.
      b. Device loactions and labeling within panel.
      c. Spare and space locations.
      d. Power supplies and transformers.
      e. Wiring and cabeling pathways.
   6. Clearly note the proposed deviations from specified sequences and equipment, and substantiate with written explanation.

C. Samples: Submit two of each type of room thermostat and cover.

D. Design Data: Provide design data for sizing and selection of compressor.

E. Manufacturer's Instructions: Provide for all manufactured components.

F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

G. Project Record and Closeout Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   1. Complete Index of Contents.
   2. Revise shop drawings to reflect actual installation and operating sequences.
   3. Red-mark "Record" control system drawings and then turn them over to the Owner's Representative.
   4. Provide directions for calibration, adjustment, and maintenance instructions for each type of component.
   5. Shop drawings of control system showing devices, interconnections between devices, and connections to items provided by others.
   6. Specifications data sheets on each device.

H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Thermostats and Other Exposed Sensors: One of each type.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.5 WARRANTY

A. Correct defective work within a one year period after Substantial Completion.

PART 2 PRODUCTS

2.1 EXISTING CONTROL SYSTEM

A. Contractor shall connect to the existing Siemens control system. New controls shall be programmed into the existing Siemens interface software.

2.2 EQUIPMENT - GENERAL

A. Products Requiring Electrical and Control Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.3 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA1, general purpose utility enclosures with enameled finished face panel.

C. Provide common keying for all panels.

D. Control panels shall meet the following minimum requirements:
   1. Outdoors: Control panels located outdoors shall comply with NEMA 3R or 4X requirements.
      a. Other Locations: Control panels in other locations, including but not limited to occupied spaces, above ceilings, and plenum returns shall comply with NEMA 1 requirement.
   2. Provide panels of adequate size to accommodate instruments for future expansion of approximately 25% beyond space required for this scope of work.
   3. Cabling shall be terminated on rugged and easily accessible terminal strips. Each termination shall be clearly marked and shall be as detailed in the shop and record drawings.
   4. Panels mounted on vibrating equipment shall have vibration isolation protection that ensures their satisfactory operation.

E. Local Control Panels:
   1. In general, the control panels shall consist of the controller(s), display module, and I/O devices - such as relays, transducers, and so forth - that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.
   2. All I/O connections on the controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.
   3. All other wiring in the panel, internal and external, shall be made to additional line or low-voltage, color-coded, and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service, and provide adequate clearance for field wiring.

4. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
5. A convenience 120 VAC duplex receptacle, fused on/off power switch, and required transformers shall be provided in each enclosure.

2.4 GENERAL FOR UNITARY CONTROLLERS FOR COOLING AND HEATING TERMINAL UNITS

A. Unitary Controllers (UC) shall be fully programmable controllers with operating sequences maintained in EEPROM or flash ROM. Customization of sequences of operation, operating parameters, control loop parameters, control constants, and schedules shall be changeable on-site by the subcontractor technician or Owner's representative. UC shall provide an interface via PIM to the field instrumentation and final control elements of the following types of equipment:
   1. One terminal unit.
   2. Up to three miscellaneous fans.
   3. One fan coil unit.
   4. Miscellaneous input monitoring.

B. All other types of equipment and systems shall be controlled by panels meeting the requirements of DCP.

C. Provide as part of the UC differential pressure transducers for the monitoring of the terminal unit primary air flowrate. The differential pressure transducer shall meet, at minimum, the requirements:
   1. Monitor the differential pressures generated by a multi-point averaging device located in the primary air duct. The terminal unit manufacturer shall provide the multi-point averaging sensors. Coordinate with the terminal unit manufacturer for range of pressure differential.

D. The differential pressure sensors, where required for the equipment served, shall monitor the flowrates with an accuracy of + or - 5 percent with a the velocity pressure minimum of +/- 0.002 inch w.c. with a working pressure range of 0-2 inch w.c.. The BMCS subcontractor shall assist the Testing and Balancing subcontractor to calibrate each differential pressure sensor in the field following installation.

E. Provide a wall mounted space temperature sensor for the monitoring of each equipment/terminal unit space temperature.
   1. The pressure differential transducers shall be on the UC. The terminal unit manufacturer as part of the factory installation shall provide tubing from these sensors to the multi-point averaging devices.
   2. Provide a one-micron filter on the pressure differential sensor if it monitors a moving air stream.
   3. If an automatic calibration program requires the automatic zeroing of the flow sensor and transducer, provide a coordinated sequence of operation that ensures the associated AHU is not operating during the automatic calibration procedure.

2.5 UNITARY CONTROLLERS - COOLING AND HEATING AIR TERMINAL UNITS

A. Provide as part of the UC differential pressure transducers for the monitoring of the terminal unit primary air flowrate. The differential pressure transducer shall meet, at minimum, the requirements:
   1. Monitor the differential pressures generated by a multi-point averaging device located in the primary air duct. The terminal unit manufacturer shall provide the multi-point averaging sensors. Coordinate with the terminal unit manufacturer for range of pressure differential.

B. Local Keypad and Display for each Controller:
   1. Use for interrogating and editing data.
   2. The pressure differential transducers shall be on the UC. The terminal unit manufacturer as part of the factory installation shall provide tubing from these sensors to the multi-point averaging devices.
   3. System security password prevents unauthorized use.

2.6 POWER SUPPLIES AND TRANSFORMERS

A. DC Power Supplies:

B. Each FPTU terminal unit shall have a UC meeting the above specified requirements for UC. The number and location of terminal units and air flowrates shall be as indicated on the Mechanical Drawings. The FPTU UC shall be fully programmable and shall not be application specific.

C. The terminal unit manufacturer shall provide the following components for each fan powered terminal unit for interface and mounting of the UC:
   1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75 percent of the rated capacity of the power supply.
   2. Primary air dampers to be controlled by the UC.
   3. Input: 120 VAC +10 percent, 60 Hz.
   4. Output: 24 VDC.
   5. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
   6. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
   7. 24 VAC control transformer.
   8. 24 VAC contacts for each stage of electric heat.
   9. 0-10 Vdc fan flowrate and start/stop controller to the ECM motor.
   10. Line Regulation: +0.05 percent for 10 percent line change.
   11. Load Regulation: +0.05 percent for 50 percent load change.
   12. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
   13. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
   14. A power disconnect switch shall be provided next to the power supply.

D. Transformers and Air Terminal Unit Power:

1. Input frequency of 50/60 Hz.
2. Internal circuit breaker.
3. Foot Mounted
4. Temperature range of 32 Deg. F. to 104 Deg. F.
5. Sized to provide volts and amps as required for connected load.
6. Input voltage shall be as required for the specific application.
7. Transformers shall be panel mounted:
    a. Panels located in mechanical or electrical rooms shall comply with NEMA 4 requirements.
    b. Panels in other locations, including but not limited to occupied spaces, above ceilings, and plenum returns shall comply with NEMA 1 requirement.
    c. Transformers and UPS can occupy the same panel enclosure.
    d. Transformer panels cannot contain other BMCS compoenets unless properly shielded.

E. DDC Power Supply Panel with Transformers:
1. Transformer: 500 VA
2. Over Current Protection: Circuit Breaker
3. Primary: 480/277/240/120 VAC
4. Frequency: 50/60 Hz
5. Nominal Dimensions: 12" x 12" x 6"
6. Approvals: Class 2 (UL Approved UL5085-3), UL916, UL508, C-UL, CE, RoHS
7. Housing: NEMA1 Metal Enclosure, Plenum Rated
8. Weight: 30.16 lbs.
9. 5 Secondaries: 24 VAC, with LED Indicators
10. 24 VAC ON/OFF: On / Off Switch & Breaker
11. Input: 480/277/240/120 VAC, Finger-Safe Terminals
12. Output: 5 Isolated, Floating 100 VA Class 2 24 Vac Terminals
13. Ambient Temperature Derating: 4A up to 40 degrees C; 3A up to 50 degrees C ; 2A up to 55 degrees C (When All 5 Outputs Operated Simultaneously)
14. Standby Wattage: 48.5 W @ 120 VAC
15. Full Load Primary Current: 4.6 A @ 120 VAC
16. Basis of Design: Functional Devices, Inc. Model no.: PSH500A, Enclosed Power Supply

F. Uninterruptable Emergency Power Supplies (UPS):
1. Output:
    a. Output Power Capacity: 1920 Watts / 1920 VA
    b. Max Configurable Power: 1980 Watts / 2200 VA
    c. Nominal Output Voltage: 120V
    d. Output Voltage Distortion: Less than 5%
    e. Output Frequency (sync to mains): 50/60Hz +/- 3 Hz
    f. Topology: Line Interactive
    g. Waveform Type: Sine wave
    h. Output Connections: (8) NEMA 5-15R, (2) NEMA 5-20R
2. Input:

a. Nominal Input Voltage: 120V
b. Input Frequency: 50/60 Hz +/- 3 Hz (auto sensing)
c. Input Connections: NEMA 5-20P
d. Cord Length: 6 feet (1.83 meters)
e. Input voltage range for main operations: 82 - 144V
f. Input voltage adjustable range for mains operation: 75 - 154V

3. Batteries & Runtime:
   a. Battery Type: Maintenance-free sealed Lead-Acid battery with suspended electrolyte : leakproof
   b. Typical recharge time: 3 hour(s)
4. Energy Use/Efficiency:

	Load	Efficiency
b.	25%	97.4%
c.	50%	98.2%
d.	75%	98.2%
e.	100%	98.1%

5. Communications & Management:
   a. Interface Port(s): (1) SmartSlot
   b. Control panel: Multi-function LCD status and control console
   c. Audible Alarm: Alarm when on battery : distinctive low battery alarm : configurable delays
   d. Emergency Power Off (EPO)
6. Surge Protection and Filtering:
   a. Surge energy rating: 530 Joules
   b. Filtering: Full time multi-pole noise filtering : 0.3% IEEE surge let-through : zero clamping response time : meets UL 1449
7. Environmental:
   a. Operating Environment: 32 - 104 °F
   b. Operating Relative Humidity: 0 - 95%
   c. Operating Elevation: 0-10000 feet
   d. Storage Temperature: 5 - 113 °F
   e. Storage Relative Humidity: 0 - 95%
   f. Storage Elevation: 0-50000 feet
   g. Audible noise at 1 meter from surface of unit: 45.00 dBA
   h. Online Thermal Dissipation: 275.00 BTU/h
8. Conformance:
   a. Regulatory Approvals: CSA, ENERGY STAR (USA), FCC Part 15 Class A, UL 1778
   b. Standard Warranty: 3 years repair or replace (excluding battery) and 2 year for battery, optional on-site warranties available, optional extended warranties available

2.7 LOW VOLTAGE CONTROL CABLE

A. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. All wiring running exposed in air plenums shall be plenum cable.

C. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC, and General Purpose Cabling:
1. Cable shall consist of copper conductors not less than #18 AWG stranded.
2. Cable shall be two- or three-conductor twisted cable with a drain wire.
3. Cable shall have a 100 percent overall shield.
4. Cable shall be plenum rated.
5. Cable shall meet or exceed NEC voltage rating of 300 volts.
6. Cable shall be NEC type CMP.
7. Cable shall meet or exceed UL temperature rating of +60 deg C.
8. Cable shall be labeled at a minimum of every 18 inches with the DDC system manufacturer's name and the type of signal carried within the cable, i.e., analog input, analog output, binary input, binary output, 24 VAC.

D. Primary and Secondary Communications Network Cabling:
1. Cable shall be of type recommended by the DDC system manufacturer.
2. Cable shall be shielded.
3. Cable shall be plenum rated.
4. Cable shall meet or exceed NEC voltage rating of 150 volts.
5. Cable shall meet or exceed UL temperature rating of +60 deg C.

2.8 CONTROL VALVES

A. Control Valve General Requirements:
1. Valve Assembly: Provide commercial-grade valve type unless otherwise indicated.
2. Identification Tag: Custom octagon type, brass, engraved.
   a. Information: Show Cv with fail setting.
   b. Fastened: Beaded chain, brass.
3. Valve Selection:
   a. Flow Characteristic:
      1) Equal Percentage: Water, brine and liquid service.
      2) Linear: Steam service.
   b. Sizing:
      1) Pipe Line Size: Use for 2-position (open/close) and solenoid types.
      2) Cv (Valve Coefficient): Size using expected load flow and pressure drop across branch which includes coil, pipe, and fittings.

B. Ball Valves:
1. Service: Use for brine (30 percent glycol), chilled water, or hot water.
2. Flow Characteristic: Include 2-way and 3-way diverting operation configured to fail normally closed (NC).
3. Replacements in Kind: Provide pressure-independent type.
4. Rangeability: 500 to 1.
5. ANSI Rating: Class 150.

6. Leakage: Class IV (0.1 percent of rated capacity) per {\rs\#1}.
7. Body Size:
    a. Under 2-1/2 inches:
        1) Connection: NPT.
        2) Materials:
            (a) Body: Brass.
            (b) Flanges: Ductile iron.
            (c) Ball: Chrome-plated brass.
            (d) Stem: Nickel-plated brass.
            (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
            (f) Stem Seal: EPDM O-Rings.
            (g) Flow Control Disk: Thermoplastic synthetic-resin.
    b. 2-1/2 inches and Above:
        1) Connection Type: Flanged.
        2) Materials:
            (a) Body: Brass.
            (b) Flanges: Ductile iron.
            (c) Ball: 300 series stainless steel.
            (d) Stem: 300 series stainless steel.
            (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
            (f) Stem Seal: EPDM O-Rings.
            (g) Flow Control Disk: Thermoplastic synthetic-resin.
    c. Service Temperature:
        1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
        2) Ambient Side: From minus 4 to 122 degrees F.

C. Globe Pattern:
1. Service: Use for brine (30 percent glycol), chilled water, hot water, or steam.
2. Flow Characteristic: Include 2-way and 3-way mixing operation configured to fail normally open (NO).
3. Body Size:
    a. Under 2-1/2 inches:
        1) Connection: NPT.
        2) Materials:
            (a) Body: Cast bronze.
            (b) Bonnet: Brass.
            (c) Stem: Stainless steel.
            (d) Plug: Brass.
            (e) Seat: Brass against elastomeric disk
            (f) Packing: Self-adjusting ethylene propylene rubber (EPR) ring pack u-cups.
        3) Rangeability: Five to one.
        4) Leakage: Class III per {\rs\#1}.
        5) Maximum Pressure Differential: 25 psig.
        6) Service Temperature:

(a) Fluid Side: Standard, 32 to 200 degrees F (0 to 93 degrees C).
(b) Ambient Side: 32 to 104 degrees F.

b. 2-1/2 inches and Above:
1) Connection: Flanged.
2) Materials:
(a) Body: Cast Iron with black lacquer finish.
(b) Stem: 316 or 303 stainless steel.
(c) Trim: Bronze (chilled, hot water, and brines).
(d) Plug: Brass packing, ethylene propylene terpolymer (EPT) ring packs.
(e) Packing: EPDM o-ring (chilled, hot water, and brines).
3) Rangeability: 100 to one.
4) Maximum Pressure Differential: 25 psig.
5) Leakage: Class III per {\rs\#1}.
6) ANSI Rating: Class 125 per {rs#1}
7) Service Temperature:
(a) Fluid Side: High temp, 32 to 250 degrees F (0 to 121 degrees C) liquid or 15 psig (103.4 kPa) steam.
(b) Ambient Side: 32 to 104 degrees F.

D. Butterfly Pattern:
1. Service: Use for brine (30 percent glycol), chilled water, condenser water, or hot water.
2. Flow Characteristic: 2-way operation configured to fail normally closed (NC).
3. Connection Type: Flanged.
4. Rangeability: 10 to 1 between the 30 to 70 degrees F range.
5. Maximum Fluid Velocity: 12 feet/sec.
6. Leakage Rating: Bubble-tight at rated maximum differential pressure.
7. ANSI Rating: Class 250 per {rs#1}
8. Size: 12 to 20 inches.
9. Materials:
a. Body: Cast iron.
b. Disc: 304 stainless steel.
c. Seat: EPDM (ethylene propylene diene monomer), peroxide-cured.
d. Stem: 416 stainless steel.
e. Tee: Ductile iron (3-way valves only).
10. Service Temperature:
a. Fluid Side: Minus 40 to 250 degrees F liquid or 15 psig steam.
b. Ambient Side: Minus 22 to 122 degrees F.

2.9 CONTROL DAMPERS

A. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch.

B. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.

1. Dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required.
2. Dampers used for mixing of airstreams (OA & RA) shall be parallel blade type arranged for mixing, with blades directing the airstreams together.
3. Multiple section dampers may be jack shafted to allow mounting of actuators. Each end of the jack shaft shall receive at least one actuator to reduce jack shaft twist.
4. Airfoil blade dampers of double-skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 fpm or system pressure exceeds 2.5 inches w.c., but no more than 4000 fpm or 6 inches w.c.

C. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.

D. Jamb Seals: Spring stainless steel.

E. Shaft Bearings: Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.

F. Linkage Bearings: Oil impregnated sintered bronze.

G. Leakage: Less than one percent based on approach velocity of 2000 ft per min and 4 inches wg.

H. Maximum Pressure Differential: 6 inches wg.

I. Temperature Limits: Minus 40 to 200 degrees F.

J. Blade Position Switch:
1. Type: Damper-blade attached lever.

2.10 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.

B. Frame:
1. Material: 20-gauge galvanized steel.
2. Free-area: Single cross section.
3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.

C. Blade:
1. Type: Multi-blade such as V or 3V for low to medium pressure.
2. Maximum Individual Blade Height: 8 inches.
3. Material: 12-gauge galvanized steel.
4. Authority: Opposed type, 5 to 50 percent (typically 10 percent).

D. Insulation: Water-resistant sound absorbing material.

E. Temperature Service Range: Minus 25 to 185 degrees F.

F. Other Requirements:
1. Paint Finish: Standard.
2. Sleeve or Flange: Factory-mounted standard.

2.11 ELECTRIC VALVE AND DAMPER ACTUATORS

A. Manufacturers:
1. Belimo Aircontrols (USA), Inc: www.belimo.com/#sle.
2. Honeywell International, Inc: buildingcontrols.honeywell.com/#sle.
3. Johnson Controls International, PLC: www.johnsoncontrols.com/#sle.
4. Ruskin Company: www.ruskin.com/#sle.
5. Schneider Electric: www.schneider-electric.us/#sle.
6. Siemens Industry, Inc: www.siemens.com/#sle.

B. General Requirements:
1. Assembly: Products field-installed onto dampers and valves.
2. Actuator Capacity: Next torque size above calculated load requirement for single units. Increase selected capacity by 25 percent when multiple units are required.
a. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
b. Spring return, as indicated, with auxiliary end switch and minimum position potentiometer.
1) For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator. Non-mechanical forms of fail-safe operation are not acceptable.
c. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
3. Fire Protection Systems:
a. Smoke Control: {rs#4} tested, listed, and labeled for use with {rs#3} listed dampers.
b. Fire-Smoke Control: {rs#3} tested, listed, and labeled for use with dampers complying with {rs#4} and {rs#5}.
c. Run Time: 60 second travel with a 20 second spring return on a 250 degrees F (121 degrees C) rated damper.
d. External Reset Switch: Key-operated type interfaced with fire protection device or system installed next to damper section at 48 inches above finished floor.
4. Environmental Operating Range:
a. Temperature: From minus 22 to 122 degrees F.
b. Humidity: 5 to 90 percent RH (non-condensing).
5. Manual Operators:
a. Provide latching operator per actuator.

b. Operator Type: Hand quadrant lever.

C. Valve Actuators:
1. Select operator for full shut off at maximum pump differential pressure.
2. Size for torque required for valve close off at 150 percent of total system (head) pressure for two-way valves; and 100 percent of pressure differential across the valve or 100 percent of total system (pump) head differential pressure for three-way valves.
3. Terminal unit reheat coil control valves be proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range.
4. Fail-Safe Operation: Mechanical, spring-return mechanism.
   a. Control Valve Normal Fail-Safe position:
      1) Steam to building heat exchanger: NC
      2) AHU heating coil: NO
      3) AHU cooling coil: NC
      4) Terminal unit reheat coil: NC
      5) Radiation: NO
      6) Radiant floor heating: Bypass
      7) Humidifier: NC
      8) Water Source Heat Pump: NC

D. Damper Actuators:
1. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
   a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
   b. Provide one operator for maximum 36 sq ft damper section.
2. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
3. Fail-Safe Operation: Mechanical, spring-return mechanism.
   a. Damper Normal Fail-Safe position:
      1) Outdoor Air: NC
      2) Return Air: NO
      3) Relief Air: NC
      4) Terminal Unit: NC

E. Mechanical Configuration:
1. On/Off or 2-Position:
   a. Input: 24 VAC.
   b. Power: 24 VAC.
   c. Position Feedback: Dry contact.
   d. Stroke Duration: 60 seconds, adjustable.
   e. Fail Safe Control: Spring-return.
2. Floating or Three-Position:
   a. Input: Dual, 24 VAC.
   b. Power: 24 VAC.

c. Position Feedback: Dry contacts, (open-closed status).
d. Stroke Duration: 90 seconds, adjustable.
e. Fail Safe Control: Spring-return.

3. Proportional (Modulated):
a. Input: 0 to 10 VDC.
b. External Power: 24 VDC.
c. Position Feedback: 0 to 10 VDC.
d. Stroke Duration: 60 seconds.
e. Type: Maintenance-free brushless DC Motor.
f. Fail Safe Control: Built-in energy storage, return under 20 seconds.
g. Adjustable Settings: Stroke direction, zero, span, and offset.

F. Angle of Rotation: 95-degree, adjustable range with mechanical end stop.

G. Motor Direction: Clock wise (CW) counter-clock wise (CCW) selectable.

H. Position Indicator: Scale indicator with tracking pointer.

I. Overload Protection Type: Electronic.

J. Electrical Protection: Double-insulated.

K. Provide the following features and accessories where indicated or where required to complete installation:
1. Auxiliary switches (SPST).
2. Battery backup.
3. Conduit connector.
4. Gaskets.
5. Potentiometer interface.
6. Pulse-width modulation (PWM) interface.
7. Resistor kit.
8. Terminal strip.
9. Thermal sensors.
10. Transformer.

2.12 INPUT/OUTPUT SENSORS

A. Temperature Sensors:
1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
4. Temperature Sensing Device: Compatible with project DDC controllers.
5. Performance Characteristics:
a. RTD:
1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.

2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
5) Range: Minus 40 degrees F through 220 degrees F minimum.

b. Thermistor:
1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
2) Range: Minus 25 degrees F through 122 degrees F minimum.
3) Heat Dissipation Constant: 2.7 mW per degree C.

c. Temperature Transmitter:
1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
2) Output: 4 to 20 mA.

d. Sensing Range:
1) Provide limited range sensors if required to sense the range expected for a respective point.
2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.

e. Wire Resistance:
1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.

f. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
1) Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
2) Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

g. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe with an indoor junction box service entry body.

h. Ceiling and Recessed Mount Temperature Sensors: Ceiling-mounted sensor in a low-profile housing.

i. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.

j. Room Temperature Sensors User Adjustment with Occupany Override:
1) Construct for surface or wall box.
2) Manual occupancy override and indication of occupancy status.

k. Duct Averaging Temperature Sensors:
1) Application: Air handling applications where the coil or duct area is greater than 10 square feet, or the air is affected by stratification regardless of duct size. .
2) The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet.

3) Provide sensor tube length to adequately cover the duct cross-sectional area. Multiple sensors shall be utilized as required to ensure a representative temperature reading in large ducts.
4) Use on duct sensors for ductwork 10 sq ft or larger.
5) Use averaging elements where prone to stratification with sensor length 8 ft or 16 ft.
6) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
7) The averaging sensor shall be constructed of rigid or flexible copper tubing.
8) Duct Mounted Averaging Sensor Requirements:
   (a) Sensor Type: Thermistor.
   (b) Accuracy: +/-2.7 °F at 77 °F.
   (c) Operating Temperature: -13 to 221 °F.
   (d) Sensor Tube Material: Copper.

l. Insertion Elements:
1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.

m. Duct Probe Temperature Sensors:
1) Application: Air handling applications where the coil or duct area is less than 10 square feet, and the air is not affected by stratification.
2) Sensor probe length shall be selected to provide the most representative reading from the sensed airstream.
3) Duct Mounted Sensor Requirements:
   (a) Sensor Type: Thermistor.
   (b) Accuracy: +/-0.4 °F over a 32 to 158 °F range.
   (c) Measurement Resolution: 0.1 °F.
   (d) Enclosure Material: Stainless Steel.

n. Outside Air Temperature Sensor:
1) The sensing element shall be fully encapsulated in potting material within a stainless-steel probe.
2) Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
3) Sensor Requirements:
   (a) Operating range: -40 to 122 °F.
   (b) Accuracy: +/-0.2 °F.
   (c) Enclosure Material: ABS Plastic.

o. Insertion Elements:
1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.

B. Static Pressure (Air Pressure) Sensors:

1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0 to 5 vdc with power at 12 to 28 vdc.

C. Equipment Operation (Current) Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

D. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.

E. Power Monitoring Sensors:
1. Current measurement (amps) shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum five-amp signal, which will be converted to a 4-20 mA DDC-compatible signal for use by the facility management system.
2. Current Transformer: A split core current transformer shall be provided to monitor motor amps.
   a. Operating Frequency: 50-400 Hz.
   b. Insulation: 0.6 kV class 10 kV BIL.
   c. UL recognized.
   d. Five-amp secondary.
   e. Select current ratio as appropriate for application.
3. Current Transducer: A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
   a. 6X input over amp rating for AC inrushes of up to 120 amps.
   b. Manufactured to UL 1244.
   c. Accuracy: +0.5 percent, Ripple +1.0 percent.
   d. Minimum Load Resistance: 30 kohms.
   e. Input: 0-20 amps.
   f. Output: 4-20 mA.
   g. Transducer shall be powered by a 24 VDC regulated power supply (24 VDC + 5 percent).

2.13 THERMOSTATS

A. Outdoor Reset Thermostats:
1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
2. Scale range: Minus 10 to 70 degrees F.

B. Immersion Thermostats:
   1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.

C. Electric Low Limit Duct Thermostats:
   1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
   2. Bulb length: Minimum 20 feet.
   3. Provide one thermostat for every 20 sq ft of coil surface.
   4. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

D. Electric High Limit Duct Thermostats:
   1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
   2. Bulb length: Minimum 20 feet.
   3. Provide one thermostat for every 20 sq ft of coil surface.
   4. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.14 TRANSMITTERS

A. Building Static Pressure Transmitters:
   1. One pipe, direct acting, double bell, scale range 0.01 to 6.0 inch wg positive or negative, and sensitivity of 0.0005 inch wg. Transmit electronic signal to receiver with matching scale range.

B. Air Pressure Transmitters:
   1. General: Provide dry media differential pressure transducers to monitor duct and room pressure.
      a. Media Compatibility: Dry air.
      b. Input Power: Class 2; 12 to 30 VDC; 2-wire: 20 mA max.
      c. Output: Field selectable, 2-wire, loop-powered 4 to 20 mA (DC only, clipped and capped).
      d. Pressure Ranges: 4 and 7, field selectable.
      e. Response Time:
         1) Standard: T95 in 20 seconds.
         2) Fast: T95 in 2 seconds.
         3) Switch selectable.
      f. Mode: Switch selectable, unidirectional.
      g. Display:
         1) Signed 3-1/2 digit LCD, indicates pressure.
         2) Over-range indicator.
      h. Proof Pressure (pressure differential): 3 psid.

i. Burst Pressure (pressure differential): 5 psid.
j. Accuracy: Plus/minus 1 percent f.s. (full scale) of selected range (combined linearity & hysteresis).
k. Temperature Effect (per transmitter size):
1) 1 inch w.c.: 2.0 percent per degree C.
2) 10 inch w.c.: 0.01 percent per degree C.; (Relative to 25 degrees C) 32 degrees F to 122 degrees F.
l. Zero Drift (1-year) (per transmitter size):
1) 1 inch w.c.: 2 percent maximum.
2) 10 inch: 0.05 percent maximum.
m. Zero adjust: Pushbutton auto-zero and digital input (2-pos terminal block).
n. Operating Environment:
1) 32 degrees F to 140 degrees F.
2) 0 to 90 percent RH noncondensing.
o. Fittings:
1) Brass barb.
2) 0.24 inches outer diameter.
3) {rs#1} V-O fire retardant ABS.

C. Water Pressure Transmitters (Liquid Differential Pressure Transmitters):
1. General: Provide wet media differential pressure transducers with 6 ft (1.83 m) armored cable, to allow remote pressure sensing capability using existing plumbing runs.
a. Input Power: Class 2; 15 to 30 VDC, 24VAC nominal, 50/60 Hz.
b. Maximum Current Draw:
1) DC: 125 mA.
2) AC: 280 mA.
c. Output: 3-wire transmitter; user-selectable, 4 to 20 mA (0 to 5V/0 to 10V).
d. Sensor:
1) Media Compatibility: 17 to 4 PH stainless steel.
2) Status Indication: Dual color LED.
3) Proof Pressure: 2x max. F.S. range.
4) Burst Pressure: 5x max. F.S. range.
5) Accuracy at 77 degrees F for less than or equal 20 ft:
(a) Ranges A and B: Plus/minus 1 percent F.S. typical.
(b) Range C: Plus/minus 1.5 percent F.S. typical.
(c) Range D: Plus/minus 2 percent F.S. typical.
6) Surge Damping: Electronic; 1 second averaging.
7) Long Term Stability: Plus/minus 0.25 percent.
8) Zero Offset (Bidirectional and Port Swap Modes Only: 0.5 percent.
e. Reverser:
1) Zero Adjust: Push button auto-zero and digital input (2-position terminal block).
2) Fittings:

(a) 27 NPT female thread, stainless steel 17 to 4 PH.

f. Pressure Ranges:
1) 0 psi to 50 psi (Gauge): 5 psid/10 psid/25 psid/50 psid (pressure differential).
2) 0 psi to 100 psi (Gauge): 10 psid/20 psid/50 psid/100 psid (pressure differential).
3) 0 psi to 250 psi (Gauge): 25 psid/50 psid/125 psid/250 psid (pressure differential).

g. Operating Conditions:
1) Temperature Compensated Range:
(a) 32 degrees F.
(b) TC Zero less than 1.5 percent of product F.S. (full scale) per sensor.
(c) TC Span less than 1.5 percent of product F.S. (full scale) per sensor.
2) Sensor Operating Range: Minus 4 degrees F to 185 degrees F.
3) Operating Environment: 14 degrees F to 122 degrees F; 10 to 90 percent RH noncondensing.

h. Enclosure: {rs#1}, Type 4.

i. Bypass manifold or 3-valve manifold for service and commissioning.

D. Thermowells:
1. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including well head and Greenfield fitting.
2. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
3. Thermowells and sensors shall be mounted in a threadolet or 1/2-inch NFT saddle and allow easy access to the sensor for repair or replacement.
4. Thermowells shall be constructed of brass.

2.15 OUTPUT DEVICES

A. Control Relays:
1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting bases shall be snap mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120 VAC.
5. Relays shall have an integral indicator light and check button.

2.16 FLOW SENSORS

A. Insertion Turbine Flow Meters:
1. Manufacturers:
a. Badger.
b. Onicon.
2. Furnish dual axial turbine flowmeter with all installation hardware required to enable insertion and removal of the meter without system shutdown.

3. All Parts: Meet or exceed the pressure classification of the piping system installed in.
4. Accuracy for the Insertion Turbine Flow Meter: Plus/minus 0.5 percent of the rate at calibrated velocity, within plus/minus of the rate over a 10 to 1 turn down and within plus/minus 2 percent of the rate over a 50 to 1 turn down.
5. Repeatability: Plus/minus 0.25 percent of reading.
6. The meter flow sensing element to operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate.
7. Include dry contact outputs, 4 to 20 mA, 0 to 10 VDC.
8. Fabricate the turbine rotor assembly of Series 300 stainless steel and use Teflon seats.

B. Insertion Magnetic Flow Meters:
1. Provide insertion type magnetic flow meters with all installation hardware necessary to enable the insertion and removal of the meter without system shutdown.
2. All Parts: Meet or exceed the pressure classification of the piping system installed in.
3. Accuracy: No greater than 1 percent of the rate from 2 fps to 20 fps.
4. Fabricate wetted material parts from 300 series stainless steel.
5. Include 4 to 20 mA dry contact pulse outputs, 0 to 10 VDC.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches and humidistats. Refer to Section 26 2726.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide separable sockets for liquids and flanges for air bulb elements.

F. Provide guards on thermostats in entrances.

G. Provide insulated mounting bases on thermostats and other temperature sensing devices in the following locations:
   1. Exterior walls.
   2. Masonry/CMU walls.
   3. Interior walls that back up to mechanical/utility rooms and other non-conditioned spaces.

H. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

I. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.

J. Provide isolation (two position) dampers of parallel blade construction.

K. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

L. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

M. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

N. Provide boxes, conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
   1. Provide boxes and conduit pathways (to ceiling spaces), for all wall mounted thermostats and sensors and wiring. Refer to Division 26.

3.3 CONTROL PANELS

A. Control panel for each system where more than one control device requires field mounting, (air handling units, exhaust fans, miscellaneous control systems including pump controls, heat exchanger controls, etc.). Single devices may be mounted on piping, wall or ductwork. Install local control panel where indicated on Drawings or suitable location adjacent to system served.

B. Mount panels on wall with suitable brackets or on self-supporting stand. Mount top of panels no higher than 6 ft above floor. Install panels so front cover door can swing fully open without interference.

C. Panels mounted on vibrating equipment shall have vibration isolation protection that ensures their satisfactory operation.

D. All control panels located in accessible areas be provided with keyed locks. Locks shall utilize a single master key. Provide 2 spare key sets to Owner.

E. Panel Layout:
   1. Locate controllers in lower half of panel first and upper half second.
   2. Locate terminal strips either horizontally in upper half of back panel or vertically. Do not locate terminal strips below 2'-0" or above 6' above finished floor.
   3. Separate 24 VDC and 120 VAC, wire, cable, and devices by 6" minimum space.
   4. Enclose wire and cable in wireways or bundle w/ wire ties and secure to back-panel. This does not apply to wire exiting wireways to terminal strips or panel mounted devices.
   5. Space controllers according to manufacturer's requirements with 3" minimum between controllers and other devices on panel and 6" between controller front and door mounted devices. Ensure adequate space is allowed for device heat dissipation.

3.4 SENSORS AND INPUT/OUTPUT DEVICES

A. All input and output devices shall be installed per the manufacturer's recommendation.

B. Building Differential Air Pressure Applications: Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
   1. Unless indicated otherwise, locate the exterior sensing tip near the building's main entrance.
   2. The interior sensing tip shall be inconspicuous and located within a central corridor on the same level as the entrance.

C. Outside Air Humidity Sensors: Outside air relative humidity sensors shall be installed with a rain-proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with seal-tight fittings and stainless steel bushings.

D. Outside Air Sensors: Outside air sensors shall be mounted on the north wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor

outside air temperatures accurately. Sensors exposed to solar radiation must be installed with solar shields. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the sensor element.

E. Water Pressure Sensors: Install water pressure sensors and differential pressure sensors with three-valve by-pass and pressure test ports for use in calibration and testing.

F. Low Temperature Limit Switches: Mount element horizontally across duct in a serpentine pattern ensuring each square foot of coil is protected by one foot of sensor. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

G. Duct Mount Sensors:
1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

3.5 ELECTRICAL WIRING

A. Install wiring in accordance with National Electric Code, ANSI/NFPA 70.

B. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable. All wiring running exposed in air plenums shall be plenum cable.

C. Install wiring (low and line voltage) in metal raceways or conduit unless inside control cabinet or unit enclosures. For concealed and accessible areas, plenum-rated wiring and cabling may be used.

D. Class 2 wiring not installed in conduit shall be supported every five feet from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

E. Low voltage control wiring and 24 VAC can be run in the same conduit. Power wiring 120 VAC and greater must be in a separate conduit.

F. Fastening shall be secured to walls or ceilings by means of appropriate screws, expansion screws anchors, toggle bolts, hollow wall screw anchors, nylon expansion anchors, or expansion shields. All-purpose plastic anchors are not acceptable.

G. Locate circuits, relays, transformers, or other equipment that contains or must be connected to voltages exceeding 130 volts, in separate cabinets, which may be adjacent to control panels; permanently label "DANGER 277 VOLTS" or appropriate volts.

H. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size shall be 3/4 inch.

3.6 CONTROL WIRING AND POWER CONNECTIONS

A. Provide all incidental control power and wiring required to make the equipment or systems fully operational. Coordinate with equipment manufacture incidental wiring requirements.

3.7 START-UP SERVICES

A. Verify proper location of each device and point-to-point system integrity. Correct as needed.

B. When installation is complete and automatic control system is placed in operation, adjust and calibrate all instruments and devices in system and ensure that system is operating in accord with specified sequences.

C. Diagnose component and system problems. Communicate irregularities to the appropriate contractor for correction.

D. Attend construction meetings as required to coordinate with other contractors and provide input during problem resolution.

3.8 IDENTIFICATION STANDARDS

A. If the owner utilizes a specific equipment or system indentification or naming convention, the contractor shall use for all systems, nameplates and equipment references in all project documentation.

B. Field Devices: All field devices shall be identified by a typed (not handwritten) securely attached tag label.

C. Controller Identification: All controllers shall be identified by typed (not handwritten) securely attached tag label.

D. Panel Identification: All local control panels shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure.

E. Panel Devices: All panel devices shall be identified by a typed label securely fastened to the back plate of the local control panel.

F. Raceway Identification: All the covers to junction and pull boxes of the control system raceways shall be painted blue or have identification labels stating "Control System Wiring" affixed to the covers. Labels shall be typed, not handwritten.

G. Wire Identification: All low and line voltage control wiring shall be identified by a number or name, as referenced to the associated control diagram, at each end of the conductor

cable. Identification number or name shall be permanently secured to the conductor or cable and shall be typed.

3.9 TRAINING

A. Provide demonstration and training in accordance with Section 01 7900 - Demonstration and Training.

END OF SECTION

SECTION 23 0934

VARIABLE-FREQUENCY CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable-frequency controllers for low-voltage (600 V and less) AC motor applications.

1.2 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

C. NEMA IA 10039 - Control Circuit and Pilot Devices.

D. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

E. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems.

F. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

G. NFPA 70 - National Electrical Code.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
   2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
   4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
   5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of controllers and adjacent equipment with required clearances indicated.
   2. Include wiring diagrams showing factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

E. Specimen Warranty: Submit sample of manufacturer's warranty.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Manufacturer’s detailed field testing procedures.

H. Field quality control test reports.

I. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity providing contract maintenance and trouble call-back service.

J. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

K. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
   1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
   2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.

L. Maintenance Materials: Furnish following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Electronic Trip Circuit Breakers: Provide one portable test set.
   3. Indicating Lights: Two of each different type.
   4. Air Filters: Two of each different type.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Controllers shall be UL labeled as a complete assembly. The VFC shall be UL listed for 100 kA SCCR when installed in accordance with the manufacturer's guidelines.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
   1. Authorized service facilities located within 200 miles of project site.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

1.9 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

1.10 MANUFACTURERS

A. Variable-Frequency Motor Controllers:
   1. ABB: www.abb.com/#sle.
   2. ABB/GE: www.electrification.us.abb.com/#sle.
   3. Danfoss: www.danfoss.com/#sle.
   4. Eaton Corporation: www.eaton.com/#sle.
   5. Rockwell Automation, Inc.; Allen-Bradley Products: ab.rockwellautomation.com/#sle.
   6. Schneider Electric; Square D Products: www.se.com/#sle.

7. Siemens Industry, Inc: www.new.siemens.com/#sle.
8. Yaskawa America Inc.: www.yaskawa.com

B. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

C. Variable-Frequency Motor Controller:
1. Configuration: Packaged controller, nonbypass.
2. Rectifier/Converter: Diode-based, 6-pulse type.
3. Selectable Control Method: Vector and Scalar/volts per hertz; open-loop, without feedback. Use Scalar/volts per hertz unless otherwise noted.
4. Filtering: Provide input/line reactor and or DC Bus Link.
5. Features:
   a. Braking chopper/resistor.
   b. PID control.
   c. Firefighter's override.
   d. Safety interlock.
   e. Damper/valve control.
   f. PTC motor thermistor input.

D. Single Controllers Serving Multiple Motors:
1. Control Method: Scalar/volts per hertz; do not use vector control method.
2. Provide separate overload relay for each motor; provide auxiliary contacts and control wiring as required to shut down controller upon trip of any single overload relay.
3. Consider combined length of motor leads for cable length limits.
4. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.
   a. Plain English text:
      1) The display interface shall be in complete English words for programming and fault diagnostics.
      2) Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch or vibration trip. Customized terms, such as: AHU-1 End Switch or CT-2 Vibration shall also be available.
   b. Automatic response to loss of speed reference; selectable to run motor at last known speed, run motor at designated speed, or stop motor.
   c. PID Control: Provide integral PID controller employing feedback for closed-loop control where indicated or required.
   d. Selectable frequency-skipping; minimum of three independently adjustable bands.
   e. Automatic catching of rotating motor.
   f. Energy-saving algorithms.
   g. Firefighter's Override: Provide firefighter's override capability where fans are used for active smoke control or post-fire smoke removal; upon activation of designated input, operate motor at designated speed without regard to noncritical faults and other inputs; operational in both drive and bypass modes where applicable.

h. Safety Interlock: Provide permissive run safety interlock capability where indicated or required; upon activation of designated input, stop and prevent operation of motor; operational in both drive and bypass modes where applicable.
i. Speed reference.
j. Instantaneous power.
k. Energy.
l. Elapsed run time.
m. Controller temperature.
n. Discrete input/output status.
o. Analog input/output values.
p. Motor stalled/overtorque.
q. Motor underload.
r. External fault.
s. PTC motor thermistor input where indicated.
t. Analog Output(s): Two.
u. Relay Output(s): Two.

5. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
   a. Serial Communications: RS-485; support for BACnet MS/TP protocol.
   b. Ethernet Communications: Support for Modbus TCP and BACnet IP protocol.
   c. Remote Monitoring Capabilities:
      1) Motor run/stop status.
      2) Hand-off-auto status.
      3) Fault information.
      4) Discrete input/output status.
      5) Analog input/output values.
   d. Remote Control Capabilities:
      1) Motor run/stop command.
      2) Hand-off-auto selection.
      3) Speed adjustment.
      4) Fault reset.
   e. The controller shall be able to support a Bluetooth Advanced Control Panel. The Bluetooth control panel shall be FCC and QDL (Qualified Design Listing) certified:
      1) A free app (iOS and Android) shall replicate the control panel on a mobile device or tablet. The control panel's programming and control functionality shall function on the device. Customizing text, such as AHU-1 End Switch, shall be supported by the device's keyboard.
      2) Bluetooth connectivity shall allow uploading, downloading, and emailing of parameters.
      3) Bluetooth connectivity shall include two pairing modes: Always discoverable with a fixed passcode, and manual discovery with a unique generated passcode every pairing.
   f. Remote monitoring and programming capability via web browser.

6. Provide input surge protection.
    a. Ambient Temperature: Between 32 degrees F and 104 degrees F.
7. Controllers shall be UL labeled as a complete assembly. The VFC shall be UL listed for 100 kA SCCR when installed in accordance with the manufacturer's guidelines.
    a. Indoor Clean, Dry Locations: Type 1 or Type 12.
    b. Outdoor Locations: Type 3R or Type 4.
    c. Hazardous/Classified Locations: Type 7/9, as required for classification of installed location.
8. Enclosure Space Heaters:
    a. Provide in each controller enclosure installed outdoors and in unconditioned indoor spaces.
    b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
    c. Heater Control: Thermostat.
    d. Heater Power Source: Provide connection to transformer factory-installed in enclosure or suitable external branch circuit as indicated or as required.

E. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

F. Interface with Other Work:
1. Provide products compatible with other systems requiring interface with controllers.
2. Interface with building automation system.
    a. Capable of remote monitoring and control of controllers.
3. Interface with fire alarm control system as specified in Section 28 4600.
    a. Capable of affecting operation of selected HVAC equipment for selected fire alarm system events.

G. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Comply with NEMA ICS 2.
3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
4. Trip-free operation.
5. Visible trip indication.
6. Resettable:
    a. Employ manual reset unless otherwise indicated.
    b. Do not employ automatic reset with two-wire control.

H. Circuit Breakers:
1. Motor Circuit Protectors:
a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of listed combination motor controller with overload protection; ratings, configurations, and features as indicated or as required.
b. Provide field-adjustable magnetic instantaneous trip setting.

1.11 ACCESSORIES

A. Auxiliary Contacts:
1. Comply with NEMA IA 10039.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each bypass motor starter, minimum.

B. Control and Timing Relays:
1. Comply with NEMA IA 10039.
2. Provide number and type of relays indicated or required to perform necessary functions.

C. Control Power Transformers:
1. Size to accommodate burden of contactor coil(s) and connected auxiliary devices.
2. Include primary and secondary fuses.

D. Control Terminal Blocks: Include 25 percent spare terminals.

1.12 CASING MOUNTED VIBRATION ISOLATION

A. Galvanized steel, strut-style, channel mounting support framework.

B. Channel inserted, 45 durometer neoprene isolation strip.

C. Basis of Design: Eaton B-Line, Model BVS - Vibra Strip.

1.13 SOURCE QUALITY CONTROL

A. Factory test controllers in accordance with NEMA ICS 61800-2.

PART 3 EXECUTION

2.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of controllers are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to accept controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

2.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.

C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 23 0529.

F. Install controllers plumb and level.

G. Unless otherwise indicated, mount floor-mounted controllers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Install field-installed devices, components, and accessories.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

2.3 FIELD QUALITY CONTROL

A. Provide services of manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.

D. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

E. Molded Case Circuit Breakers: Perform inspections and tests listed in {rs#1}, Section 7.6.1.1. Tests listed as optional are not required.

F. Packaged Controllers with Bypass: Test for proper operation in both drive and bypass modes.

G. Test for proper interface with other systems.

H. Correct deficiencies and replace damaged or defective controllers or associated components.

I. Submit detailed reports indicating inspection and testing results and corrective actions taken.

2.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

2.5 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

2.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

C. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain VFCs.

D. Provide a minimum of two hours of on-site instruction for the Owner’s designated representative regarding the proper operation of each drive. Instruction shall be done at the convenience of the Owner. Instruction shall include a description of the functions of all indicators and controls and a demonstration of the following:
1. Normal operating procedures - automatic mode.
2. Normal starting, stopping and speed control procedures - manual mode.
3. Bypass mode operation.

4. Emergency shutdown.

2.7 PROTECTION

A. Protect installed controllers from subsequent construction operations.

2.8 MAINTENANCE

A. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 4 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

SECTION 23 0993

SEQUENCE OF OPERATIONS FOR BUILDING MANAGEMENT CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
1. Heating water system.
2. Exhaust fans.
3. Cabinet heaters.
4. Fan coil units.
5. Unit heaters.

1.2 SYSTEM DESCRIPTION

A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

1.3 SUBMITTALS

A. Specification Compliance Review.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
3. Include at least the following sequences:
a. System off.
b. Start-up.
c. Warm-up mode.
d. Normal operating mode.
e. Unoccupied mode.
f. Shutdown.
g. Capacity control sequences and equipment staging.
h. Temperature and pressure control, such as setbacks, setups, resets, etc.

i. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
j. Effects of power or equipment failure with all standby component functions.
k. Sequences for all alarms and emergency shut downs.
l. Seasonal operational differences and recommendations.
m. Interactions and interlocks with other systems.

4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
6. Include schedules, if known.

C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
1. Label with settings, adjustable range of control and limits.
2. Include flow diagrams for each control system, graphically depicting control logic.
3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
5. Include all monitoring, control and virtual points specified in elsewhere.
6. Include a key to all abbreviations.

D. Points List: Submit list of all control and monitor points indicating at least the following for each point.
1. Name of controlled system.
2. Point abbreviation.
3. Point description; such as dry bulb temperature, airflow, etc.
4. Display unit.
5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
8. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

E. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.4 CONTROL SYSTEM INTERFACES

A. System shall fully support a multi-vendor environment and be able to interface and integrate third party systems and sequences via vendor protocols including, as a minimum, BACnet, LonTalk and Modbus.

B. A watchdog procedure must be implemented that enables the identification of the point of failure, i.e., where in the communications chain between the two systems did the failure occur. The watchdog function must operate at a frequency that detects a failure within 60 seconds.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 OPERATING SEQUENCES - GENERAL

A. Sequence of Control indicated illustrates basic control function only. Provide all control devices required for controlling air handling units, exhaust fans, physical plant equipment, terminal equipment, and all related items. Provide monitoring only devices as indicated.

B. Perform the initial input of all required operational data for each point that is to be used based on information supplied by the Owner. Assist the Owner's staff in developing the schedule and shall demonstrate the operation of the system using the data.

C. Provide adequate English language notation in the software to assist the operator in understanding the intent of the programmed sequences.

D. Provide stable operation of all control loops. If the Contractor has not provided self-tuning PID control algorithms then the Contractor shall manually tune all control loops. Verify all control loops are stable whether or not they are self-tuning.

E. Provide any modifications to the operating sequence programs as requested by the Owner without additional costs until the final acceptance of the entire control system.

F. All outputs using PID control shall be adjusted to the actual range of end device. Example: If VFC range is from 20% to 100%, output PID loop shall run from 20%-100% to eliminate spooling of PID outside actual operating range of end device.

G. Graphics shall represent actual range of outputs.

3.2 EQUIPMENT RUN TIME TOTALIZATION

A. Incorporate run time totalization techniques into the programming logic that will accumulate the operating times for motors as selected by the operator using an

interactive procedure. Any piece of equipment that has its status monitored by the building management control system (BMCS) shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the BMCS.

B. The operator shall be able to establish on-line, using an interactive procedure, a value for the accumulated operating time at which a suitably worded message shall be output to the operator advising that the reporting limit has been reached for a specific motor. The message shall be output at the designated device.

C. The operator shall be able to change the accumulated total for any motor to any value.

D. The accumulated operating times shall be updated at least every 15 minutes.

E. The operator shall be able to obtain on demand or on a scheduled basis a report detailing the accumulated operating times.

F. Operating time software shall be used as the basis for equipment operating selection and standby status. Changeover of units based on operating times shall not take place more than an operator-defined period, initially set at once per week.

3.3 NIGHT (UNOCCUPIED) SETBACK - SETUP

A. Incorporate unoccupied setback-setup techniques into the programming logic to provide the following:
   1. Start HVAC equipment after normal hours of scheduled operation to maintain building after-hour setpoints, while reducing energy consumption.
   2. Night setback temperatures for heating shall be initially set at 55 degrees F to activate the heating equipment and 60 degrees F to stop the heating equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation. Coordinate the operation of this program with the requirements for terminal unit controls.
   3. Night setup temperatures for cooling shall be initially set at 90 degrees F to activate the cooling equipment and 85 degrees F to stop the cooling equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation. Coordinate the operation of this program with the requirements for terminal unit controls.

B. The operator shall be able to implement this function for all HVAC equipment using an interactive procedure on an individual or group-controlled basis.

C. The operator shall be able to assign minimum run times for each piece of equipment.

D. The operation of this program shall be disabled when the outside air temperature is outside operator defined limits, initially set at 35 degrees F and 95 degrees F.

E. A report shall be available on demand and on a scheduled basis, which provides the following information:
   1. Night setback/setup setpoints and associated equipment.

F. This feature shall only be implemented for equipment in the BMCS software control mode.

G. Setpoints for each associated piece of equipment shall be displayed on the associated system display graphics. Setpoints shall be changeable via the graphical display.

H. The current status of night setback - setup modes shall be indicated on the associated system graphic.

3.4 OPTIMIZED SCHEDULING

A. Provide an adaptive software program that shall:
   1. Start HVAC equipment at the latest possible time while ensuring that space in the building reaches setpoint conditions by the time occupancy commences.
   2. Stop HVAC equipment at the earliest possible time while ensuring that space in the building shall still be within the setpoint deadband at the scheduled end of occupancy.

B. The operator shall be able to implement this function for each group of terminal units and other HVAC equipment using an interactive procedure. A group of terminal units shall comprise all the terminal units on the same floor of the tower served by the same air handling unit. The operator shall be able to assign start of occupancy and end of occupancy times for each day of the week and for holidays. A separate Monday schedule should be provided for earlier start times.

C. This program shall base the determined equipment start and stop times on monitored data such as space temperatures within the area served by the equipment and ambient conditions. If the BMCS subcontractor requires information other than that provided by the monitoring detailed in the Field Termination Schedules, then the necessary additional instrumentation shall be provided within the base bid price.

D. The operator shall be able to assign limits to the start and stop times. Initially these limits shall be set as follows:
   1. BMCS determined start times shall not be more than three hours before the scheduled occupancy.
   2. BMCS determined stop times shall not be more than one hour before the scheduled end of occupancy.

E. A report shall be available on demand and on a scheduled basis, which provides the following information:
   1. Occupancy schedules.
   2. Time of last equipment start and space conditions at scheduled occupancy time.

3. Time of last equipment stop and space conditions at scheduled end of occupancy time.

F. This feature shall only be implemented for equipment in the BMCS software control mode.

3.5 HEATING WATER SYSTEM

A. System Off - When the system is off:
   1. The boilers shall be disabled.
   2. The heating water pumps shall be off.

B. Initiation of System Start-Up - The system shall be started:
   1. Manually initiated by operator through BMCS.
   2. Automatically by the BMCS base on a time schedule or whenever there is a requirement for heating.

C. System Operation - After system start-up has been initiated the following shall occur:
   1. Sequential Boiler Control:
      a. The lead heating water pump and boiler shall be selected by one of the following operator selectable methods:
         1) Operator selection of individual equipment.
         2) Run times to equalize equipment operations.
      b. The lead pump shall start.
      c. The lead boiler shall start.
      d. The boilers shall stage up to maintain the system heating water supply temperature setpoint.
         1) Condensing boilers B-1, B-2, and B-3 shall be enabled and exceed 90% of maximum capacity for 10 minutes before enabling B-4.
         2) B-3 shall be omitted from the sequence when it is enabled for snow melt.
      e. The boilers shall shall stage down if the plant has been at the current stage for more than 10 minutes and capacity required is 80% below the next stage down.
      f. The boiler units shall be enabled to start under control of the unit-mounted controllers.
      g. The unit-mounted controllers shall control the heating water supply temperature setpoint.
      h. Provide a heating water temperature setpoint reset schedule based on outdoor air temperature.
      i. If a boiler or pump fails in service the unit shall be disabled and the standby boiler or pump shall be enabled without any time delays.
      j. The heating water pump speed shall modulate to maintain the system differential pressure setpoint. This sensor should be located at least 2/3 the way down the system or in the location indicated on the mechanical

drawings. If multiple pumps are operating, their speeds shall be controlled by a common signal.

D. System Shutdown - Shall be initiated as follows:
   1. Manually initiated by operator through BMCS.
   2. Automatically by the BMCS base on a time schedule or whenever there is not a requirement for heating.

E. System Setpoints - The setpoints shall be operator changeable and initially set as follows:
   1. Heating water supply temperature setpoint shall be between 120 and 180 degrees F.
   2. The heating water pump differential pressure setpoint shall be 15 psi.
   3. The high/low temperature alarm setpoint shall be set initially at 10 degrees F above/below the temperature setpoint.

F. Software Interface - The following points shall be provided through the BACnet interface.
   1. Boiler fire rate.
   2. Boiler supply temperature reset.
   3. Boiler pre-alarm.
   4. Boiler internal supply temperature setpoint

G. Alarms - The BMCS shall generate an alarm for the following conditions:
   1. Pump failure.
   2. High/low heating water supply temperature.

H. Failure Positions - The following shall occur upon component failure or loss of power:
   1. Pumps shall remain in the last commanded state.
   2. Boilers shall remain in the last commanded state.
   3. Heat exchanger valve(s) shall fail open.

I. Points List:
   1. Analog Inputs:
      a. Heating water return temperature.
      b. Heating water supply temperature.
      c. Heating water system differential pressure.
   2. Digital Inputs:
      a. Boiler general alarm (Typ 2).
      b. Heating water pump status (Typ 2).
   3. Analog Outputs:
      a. Heating water pump VFC speed (Typ 2).
      b. Boiler supply temperature setpoint reset (Typ 2).
      c. Heat exchanger valve.
      d. Heat exchanger 1/3 valve.
      e. Heat exchanger 2/3 valve.
   4. Digital Outputs:
      a. Boiler enable/disable (Typ 2).

b. Heating water pump start/stop (Typ 2).

3.6 FAN COIL UNITS

A. System Off - When the system is off:
1. The supply fan shall be off.
2. The chilled water valve shall be closed.
3. The heating water valve shall be closed.

B. Initiation of System Start-Up - The system shall be started:
1. Manually initiated by operator through BMCS.
2. Automatically by BMCS through occupancy schedule.

C. System Operation - After system start-up has been initiated the following shall occur:
1. The supply fan shall start.
2. The chilled water valve shall modulate to maintain a supply air temperature set point as calculated based on deviation from set point.
3. The heating water valve shall modulate to maintain a supply air temperature set point as calculated based on deviation from set point.
4. The occupant shall have the capability to adjust the space temperature setpoint through the space temperature sensor. The programming shall limit user adjustment to + or - 4 degrees F of the base setpoint.

D. System Shutdown - Shall be initiated as follows:
1. Manually initiated by operator through BMCS.
2. Automatically by BMCS through occupancy schedule.

E. System Setpoints - The setpoints shall be operator changeable and initially set as follows:
1. Space cooling temperature setpoint shall be 74 degrees F.
2. Space heating temperature setpoint shall be 70 degrees F.
3. The high and low temperature alarm setpoints shall be set initially at 3 degrees F above/below the temperature setpoints.

F. Alarms - The BMCS shall generate an alarm for the following conditions:
1. High temperature.
2. Low temperature.

G. Failure Positions - The following shall occur upon component failure or loss of power:
1. The supply fan shall remain in the last commanded state.
2. Chilled water valve shall fail in place.
3. Heating water valve shall fail in place.

H. Points List:
1. Analog Inputs:
a. Space temperature.
b. Space temperature setpoint adjust.

c. Supply/discharge air temperature.

2. Digital Inputs:
   a. Fan status.
3. Analong Outputs:
   a. Chilled water valve.
   b. Heating water valve.
4. Digital Outputs:
   a. Fan start/stop.

3.7 TRANSFER FAN (TF-1)

A. System Description: Fan provide transfer ventilation for the boiler room.

B. System off - when system is off:
   1. The exhaust fan shall be off.
   2. Motorized damper MD-1 shall be closed.

C. Initiation of System Startup:
   1. Manually initiated by BMCS operator workstation.
   2. Automatically by the BMCS based on boiler room temperature (FCU-6) exceeding set point by 5 degrees for more than 10 minutes.

D. System operation - after startup has been initiated, the following shall occur:
   1. Fan shall start.
   2. Motorized damper MD-1 shall open.

E. System shutdown - shall be initiated as follows:
   1. Manually initiated by operator at BMCS workstation.

F. Alarms - the BMCS shall generate an alarm for the following:
   1. Fan failure.

G. Failure position - the following shall occur upon BMCS communication failure.
   1. Fan shall remain in last commanded state.
   2. Motorized damper MD-1 shall fail open.

H. Field Termination Schedule:
   1. Digital input:
      a. Fan status.
      b. Damper position.
   2. Digital output:
      a. Fan start/stop.

3.8 UNIT HEATER CONTROL BMCS

A. Provide for equipment marks BH, FT, and UH-22 thru UH-30.

B. System Off - When the system is off:
   1. The fan shall be off.
   2. The heating water valve shall be closed.
   3. The steam valve shall be closed.

C. Initiation of System Start-Up - The system shall be started:
   1. Manually initiated by operator through BMCS.
   2. Automatically whenever the space temperature falls below the space temperature heating setpoint.

D. System Operation - After system start-up has been initiated the following shall occur:
   1. The fan shall start.
   2. The heating water valve shall modulate to maintain the space temperature heating setpoint.
   3. The steam valve shall modulate to maintain the space temperature heating setpoint.

E. System Shutdown - Shall be initiated as follows:
   1. Manually initiated by operator through BMCS.
   2. Automatically whenever the space temperature rises above the space temperature heating setpoint.

F. System Setpoints - The setpoints shall be operator changeable and initially set as follows:
   1. Space heating temperature setpoint shall be 70 degrees F.
   2. The low temperature alarm setpoint shall be set initially at 5 degrees F above/below the temperature setpoints.

G. Alarms - The BMCS shall generate an alarm for the following conditions:
   1. Fan failure.
   2. Low space temperature.

H. Failure Positions - The following shall occur upon component failure or loss of power:
   1. Heating water valve shall fail open.

I. Points List:
   1. Analog Inputs:
      a. Space temperature.
   2. Digital Inputs:
      a. Fan status.
   3. Analog Outputs:
      a. Heating water valve.
   4. Digital Outputs:
      a. Fan start/stop.

3.9 UNIT HEATER CONTROL STAND ALONE

A. Space thermostat shall module heating water valve to maintain the space temperature setpoint. Unit heater fan shall be cycled from an aquastat on the heating water return line.
   1. Provide for equipment marks CH-1, CH-2, CH-3, and UH-32 thru UH-62.

END OF SECTION

SECTION 23 1113

FACILITY FUEL-OIL PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping and fittings.

B. Flanges and piping components.

C. Pipe hangers and supports.

D. Valves.

E. Strainers.

F. Flexible connectors.

G. Tank management system.

1.2 REFERENCE STANDARDS

A. API Spec 5L - Line Pipe.

B. API Spec 12P - Specification for Fiberglass Reinforced Plastic Tanks.

C. API Std 650 - Welded Tanks for Oil Storage, 13th Edition.

D. API RP 1615 - Installation of Underground Petroleum Storage Systems.

E. ASME BPVC - Boiler and Pressure Vessel Code.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

G. ASME B1.1 - Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms).

H. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

I. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.

J. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

K. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

L. ASME B16.12 - Cast Iron Threaded Drainage Fittings.

M. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

N. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

O. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

P. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.

Q. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

R. ASME B18.2.2 - Nuts for General Applications: Machine Screw Nuts; and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

S. ASME B31.3 - Process Piping.

T. ASME B31.9 - Building Services Piping.

U. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

V. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

W. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.

X. ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

Y. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

Z. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

AA. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

BB. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

CC. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

DD. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).

EE. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.

FF. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

GG. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.

HH. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.

II. ASTM B247M - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings (Metric).

JJ. ASTM B687 - Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples.

KK. ASTM D229 - Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation.

LL. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

MM. ASTM D2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

NN. ASTM D5677 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type, for Aviation Jet Turbine Fuel Lines.

OO. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

PP. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

QQ. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

RR. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.

SS. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

TT. NACE SP0169 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems; NACE International; 2007.

UU. NACE SP0286 - Electrical Isolation of Cathodically Protected Pipelines.

VV. NFPA 30 - Flammable and Combustible Liquids Code.

WW. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

XX. UL 842 - Standard for Valves for Flammable Fluids

1.3 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Test Reports: Tests of piping, NFPA 31and NFPA 37

C. Certificates: Certify that products meet or exceed specified requirements.

D. Project Record Documents: Record actual locations of piping system, storage tanks, and system components.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Welding Materials and Procedures: Comply with ASME BPVC.

B. Welders Certification: In accordance with ASME (BPV IX).

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

D. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience and approved by manufacturer.

E. Valves: Manufacturer's name and pressure rating marked on valve body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

A. Regulatory Requirements:
   1. Comply with the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
   2. Comply with ASME B31.9 for installation of fuel oil piping.
   3. Comply with applicable regulations for installation of fuel oil system.
   4. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of fuel oil system.

5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Comply with the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.

C. Carbon Steel Pipe:
1. Comply with One of the Following:
a. ASTM A53/A53M, Type E or S, Grade B, seamless or electric welded, Schedule 80 for pipe less than 2-1/2 inches in diameter or Schedule 40 for pipe 2-1/2 inches in diameter and larger.
2. End Connections:
a. Forged, socket weld type, complying with ASTM A182/A182M and ASME B16.11 for pipe or fittings less than 2-1/2 inches.
b. Buttweld type complying with ASTM A234/A234M, Grade WPB and ASME B16.9 for pipe or fittings 2-1/2 inches and larger of the same wall thickness as the adjoining pipe.
c. Threaded type complying with ASME B16.3, Class 150 or ASME B16.11.

D. Reinforced Thermosetting Resin Plastic (RTRP) Pipe: ASTM D2310 and ASTM D2996, UL listed filament wound fiberglass reinforced epoxy pipe with integral epoxy liner and exterior coating.
1. Fittings: Compression-molded, filament-wound, fiberglass-reinforced epoxy.
2. Joints: Tapered bell and spigot adhesive bonded.

E. Exterior Containment Piping System: Factory fabricated, double-wall complying with ASME B31.3 and NFPA 30.
1. Physical Characteristics:
a. Fiberglass reinforced plastic (FRP) complying with ASTM D5677.
b. Chemically compatible with type of fuel handled.
c. Non-corrosive.
d. Dielectric.
e. Non-biodegradable.
f. Microbial resistant.
g. Pressure Limitation: Capable of withstanding 5 psig minimum air pressure.
2. Design Characteristics:
a. Piping and support allow for drainage.
b. Allows for complete inspection of the product piping prior to sealing of containment piping.
c. Pipe Supports:
1) Design based on pipe size, pipe weight, fuel weight, and operating condition to evenly separate containment piping from product piping.
2) Construct of same material as product piping.
3) Design supports so no point loading occurs on the primary or exterior pipe.
4) Permanently attach supports to product pipe by tack welding or adhesive.

5) Design to allow for pipe movement of both product piping and exterior containment piping without causing damage to either.

3. Product Pipe: Provide product pipe as indicated on drawings and specified in this Section.
   a. Wrought Copper and Bronze Solder-Joint Pressure Fittings: Comply with ASME B16.22 and ASTM B75/B75M.
   b. Cast Copper Alloy Solder-Joint Pressure Fittings: Comply with ASME B16.18.
   c. Cast Copper Alloy Fittings for Flared Copper Tube: Comply with ASME B16.26 and ASTM B62.
   d. Brass or bronze adapters for brazed tubing acceptable for connecting tubing to flanges and threaded ends of valves and equipment.

2.2 FLANGES, COUPLINGS, AND PIPING COMPONENTS

A. Flanges:
1. Provide flanged end connections on equipment, fittings, piping, piping components, adapters, couplings, and valves complying with ASME B16.5, Class 150.
2. Carbon Steel: Comply with ASTM A105/A105M.
3. Stainless Steel: Comply with ASTM A182/A182M, Grade F304 or F304L, forged type.
4. Aluminum: Comply with ASTM B247 (ASTM B247M), Alloy 6061-T6.
5. Gaskets, Non-Isolating:
   a. 1/8 inch thick.
   b. Comply with ASME B16.12, raised-faced type.
   c. Material: Buna-N.
6. Gaskets, Electrically Isolating:
   a. Comply with ASTM D229.
   b. Electrical Insulating Material: 1000 ohms resistance.
   c. Chemically compatible with fuel handled.
   d. Full face type.
   e. Provide full surface, spiral-wound, mylar, insulating sleeves between bolts and holes of flanges.
   f. Furnish bolt shank diameter not less than diameter at root of threads.
   g. Provide high-strength 1/8 inch thick, phenolic, insulating washers next to flanges with flat, circular, stainless steel washers over the insulating and under bolt heads and nuts.
   h. Supply adequate bolt length to accommodate insulating gaskets and stainless steel washers.
7. Flange Protectors:
   a. Weather and ultraviolet (UV) resistant to protect all components of flanged end connection from corrosion or damage resulting from environmental exposure.
   b. Designed to allow for quick and easy removal and re-installation.
   c. Allows for visual inspection of flanged connections in-place.
   d. Provide grease fittings for electrically isolating type.
8. Bolts, Nuts, and Washers:

a. Comply with ASME B18.2.1 and ASME B18.2.2.
b. Bolts:
1) Regular hexagonal type.
2) Threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch.
3) Provide sufficient length to obtain full bearing on nuts, projecting no more than two full threads beyond nuts with bolts tightened to required torque.
c. Nuts:
1) Hexagonal, heavy series type.
2) Threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch.
d. Stainless Steel Material:
1) Bolts: Comply with ASTM A193/A193M, Class 2, Grade 8.
2) Nuts: Comply with ASTM A194/A194M, Grade 8.
3) Washers: Comply with ASTM F436/F436M, flat circular.
e. Carbon Steel Material:
1) Bolts: Comply with ASTM A307, Grade B, hot-dipped galvanized.
2) Nuts: Comply with ASTM A563/A563M, Grade A, hex-style, hot-dipped galvanized.
3) Washers: Comply with ASTM F844, hot-dipped galvanized.

B. Piping Components:
1. Provide components that meet the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
2. Pressure Design Class: Class 150, as defined in ASME B16.5.
3. Welded Nipples: Comply with ASTM A733 or ASTM B687 and construct of same material as connecting pipe.
4. Steel Couplings: Comply with API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.
5. Threaded Unions:
a. Comply with ASME B16.39, Class 150.
b. Materials: Comply with ASTM A312/A312M, Grade 304 or 316.
c. Dielectric Unions: Comply with dimensional, strength, and pressure requirements of ASME B16.39, Class 150.
d. Provide galvanized or plated steel parts.
e. Furnish water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint and withstand a 600-volt breakdown test when dry.
6. Joint Compound: Resistant to water and suitable for use with fuel containing 40 percent aromatics.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to NFPA 31 and NFPA 37.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

D. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.4 GATE VALVES

A. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

2.5 GLOBE VALVES

A. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.

2.6 BALL VALVES

A. MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder.

2.7 SWING CHECK VALVES

A. MSS SP-80, Class 125, bronze body and cap, bronze swing disc, solder ends.

2.8 RELIEF VALVES

A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 60 psi, UL listed for fuel oil, capacities ASME certified and labelled.

2.9 ANTI SYPHON VALVE

A. Zinc plated ductile-iron body,zinc plated steel spring, stainless steel adjustment screw, flourocarbon seal, built in thermal expansion pressure relief valve, designed to prevent fruel from exiting the storage tank in the event of a broken line or leak. UL listed for fuel oil, capacities ASME certified and labelled.

2.10 OVERFILL PREVENTION VALVE

A. Aluminum body, teflon seat, aluminum shaft, linkage, and hardware; automatic, direct pressure actuated at minimum 5 psi, UL listed for fuel oil, capacities ASME certified and labelled.

2.11 STRAINERS

A. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

2.12 FLEXIBLE CONNECTORS

A. Bronze inner hose and braided exterior sleeve, suitable for minimum 200 psi CWP and 250 degrees F.

2.13 FUEL TANK MANAGEMENT SYSTEM

A. Locking NEMA 12 enclosure for microprocessor based controller with LED Data Display, Lithium Battery Backed RAM, Audible Alarm.

B. System shall monitor leak detectors, main tank fuel level, fuel tempeature and be fully integrated with the fuel fill panel remote annunciator panel.

C. Modbus RTU communication interface to the Building Management Control System with 20 owner selected monitoring points.

D. Provide the following additional BMCS interface:
   1. Analog output contacts:
      a. Remaining tank fuel volume

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, are dry, and have not been over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 PIPING INSTALLATION

A. Install in accordance with manufacturer's instructions and API RP 1615.

B. Provide nonconducting dielectric connections wherever jointing dissimilar metals. Install to NACE SP0286.

C. Route piping in orderly manner and maintain gradient.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide access where valves and fittings are not exposed.

G. Identify piping systems, including underground piping. See Section 23 0553.

H. Install valves with stems upright or horizontal, not inverted.

I. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

END OF SECTION

SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, specialties and connections for natural gas piping systems.

1.2 REFERENCE STANDARDS

A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.

B. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators.

C. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators.

D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

G. ASME B31.1 - Power Piping.

H. ASME B31.9 - Building Services Piping.

I. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

N. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.

O. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

P. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.

Q. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

S. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

T. AWWA C606 - Grooved and Shouldered Joints.

U. ICC (IFGC) - International Fuel Gas Code.

V. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.

W. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry.

X. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

Y. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

Z. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
   2. Joints: ASME B31.1, welded.

B. Polyethylene Pipe: ASTM D2513, SDR 11.
   1. Fittings: ASTM D2683 or ASTM D2513 socket type.
   2. Joints: Fusion welded.

2.2 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

2.3 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
   1. Fittings: ASME B16.26, cast bronze.
   2. Joints: Flared.

C. Flexible Gas Piping:
   1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
      a. Jacketing: Conductive jacket shall conform to ASTM E-84 flame spread rating not to exceed 25 and ASTM-E84 smoke density rating shall not exceed 50, and shall be resistant to UV.
   2. Comply with ASTM E84.
   3. Fittings: Provided by piping system manufacturer.
   4. Provide piping with integral lightning protection.
   5. Jacketing: Extruded fire-retarded engineered polymer designed to enhance the energy dissipating properties of the flexible gas piping. Conductive jacket shall conform to ASTM E-84 flame spread rating not to exceed 25 and ASTM-E84 smoke density rating shall not exceed 50, and shall be resistant to UV.
   6. Manifolds: Malleable iron or steel with protective coating. Include threaded connections according to ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
2. Housing Material: Provide {\rs\#1} malleable iron or ductile iron, galvanized.
3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
5. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.

2.6 BALL VALVES

A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.7 PLUG VALVES

A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.8 STRAINERS

A. Size 2 inch and Under:
   1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
   2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 1-1/2 inch to 4 inch:
   1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

C. Size 5 inch and Larger:
   1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Compliance Requirements:
   1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
   2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

B. Materials in Contact With Gas:
   1. Housing: Aluminum, steel (free of non-ferrous metals).
   2. Seals and Diaphragms: NBR-based rubber.

C. Maximum Inlet Operating Pressure: 10 psi.
   1. Appliance Regulator: 10 psi.
   2. Line Pressure Regulator: 10 psi.

D. Maximum Body Pressure: 10 psi.

E. Output Pressure Range: 1 inch wc to 80 inch wc.

2.10 GAS SPECIALTIES:

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

C. Appliance Connector Valves: ANSI Z21.15 and CSA International listed.

D. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.

E. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.

F. Electrically Operated Gas Solenoid Valves: UL 429, bronze, aluminum, or cast-iron body solenoid valve; 120-V ac, 60 Hz, Class B, continuous-duty molded coil. Include NEMA ISC 6, Type 4, coil enclosure and electrically opened and closed dual coils. Valve position shall normally be closed.

2.11 SERVICE METERS:

A. Gas service and meter will be furnished and set by gas utility company.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; refer to Section _____.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Install valves with stems upright or horizontal, not inverted.

N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.

P. Sleeve pipes passing through partitions, walls and floors.

Q. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

R. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install ball valves for throttling, bypass, or manual flow control services.

E. Provide plug valves in natural gas systems for shut-off service.

END OF SECTION

SECTION 23 2113

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, above grade.

C. Heating water and glycol piping, above grade.

D. Chilled water piping, above grade.

E. Equipment drains and overflows.

F. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 CODE AND PERMIT COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that indicated shall not be substituted.

B. Contractors shall familiarize themselves with all requirements as to permits, fees, etc., and shall comply. All permits, licenses, inspections, and arrangements required for the work shall be provided by the Contractors at their expense.

C. All utilities shall be installed in accordance with utility company rules and regulations.

D. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of piping systems. Wherever practical, install piping as indicated.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

E. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings.

F. ASME B31.9 - Building Services Piping.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

H. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

I. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts.

J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

K. ASTM A536 - Standard Specification for Ductile Iron Castings.

L. ASTM B32 - Standard Specification for Solder Metal.

M. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

O. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

P. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

Q. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

R. ASTM F3226/F3226M - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.

S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

T. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe.

U. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

V. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

W. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

X. AWWA C606 - Grooved and Shouldered Joints.

Y. IAPMO (UMC) - 2024 Uniform Mechanical Code.

Z. IAPMO/ANSI/CAN Z1117 - Standard for Press Connections.

AA. ICC (IMC) - International Mechanical Code.

BB. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 SUBMITTALS

A. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalog information.
   3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

C. Pipe pressure testing report.

D. Mechanical grooved joint couplings, fittings and specialties shall be shown on shop drawings and product submittals, and shall be specifically identified with the manufacturer’s style or series designation.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this sectionwith minimum 5 years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. Coupling Manufacturer:
   1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
   2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.

F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

G. All grooved joint couplings, fittings and specialties shall be the products of a single manufacturer.
   1. Grooving tools shall be of the same manufacturer as the grooved components.
   2. All castings used for coupling housings, fittings, etc., shall be date stamped for quality assurance and traceability.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical coupling joints may be used in any location.
      a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Grooved mechanical connections and joints comply with AWWA C606. Couplings shall be rigid pattern, two-piece, ductile-iron housing cast with offsetting angle-pattern bolt pads.
         1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
         2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
      c. Couplings to be bolt pad to bolt pad assembly, central cavity pressure-responsive design.
      d. Installation-Ready, for direct stab installation without field disassembly or loose parts.
      e. Use rigid joints unless otherwise indicated.
      f. Use flexible joints at vibrating or rotating equipment.
         1) Three (or four, depending on pipe size), flexible joints may be used in lieu of a flexible connector.
      g. Use gaskets of molded grade EHP synthetic rubber with central cavity, pressure responsive configuration and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.
      h. Provide steel coupling nuts and bolts complying with ASTM A183.

4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
5. Welded piping shall have long radius elbows.
6. Where Schedule 40 is required below, the following shall apply for larger piping: Steel Pipe Sizes 12 Inches and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
   a. Threaded Joints: ASTM A536 ductile iron fittings.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. For throttling, bypass, or manual flow control services, use globe or ball valves.
3. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.

2.3 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
4. Mechanical Press Sealed Fittings: ASTM F3226/F3226M, ICC (IMC), and IAPMO (UMC) approved, with EPDM seals.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L, drawn temper.
1. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
2. Mechanical Press Sealed Fittings: ASME B16.51 or IAPMO/ANSI/CAN Z1117, ICC (IMC), and IAPMO (UMC) approved, with EPDM seals.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, non toxic synthetic rubber sealing elements..

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:
   1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch thick, preformed neoprene.
   4. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
   5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
   6. Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
      a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
         1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
         2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

C. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
   1. Sleeve: ASTM A 126, Class B, gray iron.
   2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
   3. Gaskets: Rubber.
   4. Bolts and Nuts: AWWA C111.
   5. Finish: Enamel paint.

D. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Installation-Ready, for direct stab installation without field disassembly or loose parts.
   2. Couplings to be bolt pad to bolt pad assembly.
   3. Coupling manufacturer’s factory-trained representative shall provide on-site training for the contractor’s field personnel in the proper use of grooving tools and installation of grooved joint products. The representative shall periodically visit

the job site to ensure best practices in grooved joint installations are being followed.

4. Dimensions and Testing: In accordance with AWWA C606. Couplings shall comply with ASTM F1476 “Standard Specification for the Performance of Gasketed Mechanical Couplings for use in Piping Applications”.
5. Mechanical Couplings: Comply with ASTM F1476.
6. Housing Material: Ductile iron, galvanized complying with ASTM A536.
7. Gasket Material: Prelubricated, grade EHP, EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F. Central cavity pressure-responsive design.
8. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel. ASTM A449.
9. When pipe is field grooved, provide coupling manufacturer's grooving tools.
10. Manufacturers:
    a. Victaulic Company: www.victaulic.com.
11. Grooved Copper Tube Fittings:
    a. Fittings: ASME B16.22 wrought copper and ASTM B 75 (ASTM B 75M), copper tube or ASME B 16.18 and ASTM B 584, bronze casting.
    b. Couplings: Rigid pattern, offsetting angle-pattern bolt pads.
12. Grooved Steel Pipe and Fittings:
    a. Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings.
    b. Rigid Type Couplings: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B3 1.1 and B31.9.
    c. Flexible Type Couplings: Used in locations where vibration attenuation and stress relief are required. Use three flexible couplings in lieu of a flexible connector.

E. Pressed Fittings:
1. Copper Tube:
    a. Copper and copper alloy press fitting shall conform to material requirements of ASME B16.18 or ASME 16.22 AND Performance criteria of IAPMO PS 117.
    b. Sealing elements shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by the fitting manufacturer.
    c. On sizes 1/2" to 4" the fitting shall have a feature that assures leakage of liquids and/or gases from inside the system past the sealed elementof an unpressed connection. this function feature shall provide an easy indication of an unsealed connection.

F. Dielectric Connections:
1. **Dielectric unions shall not be used.**
2. Waterways and Nipples:
    a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    b. Dry insulation barrier able to withstand 600-volt breakdown test.

c. Construct of galvanized steel with threaded end connections to match connecting piping.
d. Suitable for the required operating pressures and temperatures.
e. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F

3. Flanges:
a. Dielectric flanges with same pressure ratings as standard flanges.
b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
c. Dry insulation barrier able to withstand 600-volt breakdown test.
d. Construct of galvanized steel with threaded end connections to match connecting piping.
e. Suitable for the required operating pressures and temperatures.
f. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

4. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.

G. Joining Materials:
1. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
2. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES

A. Manufacturers:
1. Danfoss
2. Schneider Electric
3. Bell and Gossett
4. Delta P
5. Belimo
6. Tour Anderson
7. Flow Design
8. Griswold
9. Nexus Valve, Inc

B. Valves shall be warranted for minimum of five years from date of shipment.

C. Pressure indendent control valves shall accurately control the flow from 0 to 100% rated flow.

D. Minimum operating pressure differential range of 5 to 50 PSI differential across the valve and equal or greater than the associated pump's design head pressure.

E. Valve body flow accuracy of +/- 5% total assembly error incorporating differential pressure fluctuation, manufacturing tolerances and valve hysteresis.

F. Maintain proportional and linear flow coil characteristics.

G. Provide minimum Class 4 shut-off on all sizes and field serviceable.

H. Valve bodies shall be Cast Iron or Brass. All internal parts shall be Stainless Steel.
   1. NPS 2 and Smaller: Forged brass body rated at no less than 250 PSI, stainless steel ball and stem, NPT, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.
   2. NPS 2-1/2 through 6: Cast iron body according to ANSI Class 125, standard class B, stainless steel blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.

I. Valves shall have minimum of two factory installed PTT ports capable of being used to measure pressure or temperature.

J. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.

K. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.
   1. Valves: Sized for maximum circuit flow rate and nominally, line-sized.
   2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
   3. Fail-Safe Operation: Mechanical, spring-return mechanism or capacitance return.
   4. Provide plenum-rated actuators for service above ceilings to possess UL listings and approvals.
   5. Temperature Rating: 40 to 104 degrees F.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.2 INSTALLATION

A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

B. Provide drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install piping at a uniform grade of 0.2 percent (1 inch in 40 feet) upward in direction of flow.

D. Mechanically formed tees in copper pipe may be formed per ANSI A40 by workers certified after factory authorized training. Branch lines shall be formed with two dimple/depth stops in line with the run of the tube.
1. Fabricate mechanically formed tees/outlets according to manufacturer's standard written procedure.
2. Mechanically formed outlets shall have a collar with a height not less than three times the thickness of the branch tube wall.
3. The branch shall be notched to conform to the inner curve of the run and shall be dimpled or otherwise impeded from penetrating the run pipe/tube to a depth that would obstruct the flow of fluid through the run pipe/tube.
4. The branch tube shall also be dimpled or otherwise marked to indicate the location of the notches with respect to the run.
5. Such marking shall be at a sufficient distance from the face of the joint to allow for a visual point of inspection after the joint is brazed.
6. All joints constructed using this method shall be brazed.

E. Provide non-conducting dielectric connections wherever joining dissimilar metals. **Dielectric unions are not allowed.**

F. Install and support in accordance with manufacturer's instructions.

G. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.

H. Route piping in orderly manner, parallel to building structure, and maintain gradient.

I. Install piping to conserve building space and to avoid interference with use of space.

J. Group piping whenever practical at common elevations.

K. Sleeve pipe passing through partitions, walls, and floors.

L. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

M. Slope piping and arrange to drain at low points.

N. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming off the top of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

O. Anchor piping for proper direction of expansion and contraction.

P. Provide temperature and pressure test fitting (PTT) in accordance with the contract documents and as required to test and balance all equipment.
   1. Provide a pressure/temperature test fitting (PTT) at each water sensor that is an input point to the control system.

Q. Piping shall be installed so as to allow removal of ceiling hung equipment.

R. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

S. Grooved Joints:
   1. Install in accordance with the manufacturer's latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
   3. Grooving tools shall be manufactured and supplied by the manufacturer of the couplings. Use roll sets or cut groovers compatible with the pipe material and wall thickness per manufacturer's installation instructions.
   4. Factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation. Contractor shall remove and replace any improperly installed products.
   5. Flexible type couplings can be used in locations where vibration attenuation and stress relief are required. Use three flexible couplings in lieu of a flexible connector.

T. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

U. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

V. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

W. Use eccentric reducers to maintain top of pipe level.

X. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

3.3 INCIDENTAL WORK

A. The following incidental work shall be furnished by the Contractor under the supervision of the Temperature Control Contractor:
   1. The Piping Contractor shall install automatic valves and separable wells that are specified to be furnished by the Temperature Control Contractor.
   2. The Piping Contractor shall provide all necessary valved pressure taps, water, drain and overflow connections and piping.
   3. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.

3.4 SAFETY VALVE INSTALLATIONS

A. Provide safety valves according to ASME B31.1. Pipe safety valve discharge without valves to floor near floor drain or over mop sink.

3.5 HYDRONIC SPECIALTIES INSTALLATION

A. Provide manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Provide automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

C. Provide combination air separator and strainer in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blowdown piping with gate valve and hose end.

D. Provide bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve and hose end.

E. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

F. Provide centrifugal separator as indicated. Install purge assembly and pipe discharge to drain. Provide pressure gauges on inlet and outlet.

G. Provide automatic water fill assemblies wherever domestic water connections are made to HVAC hydronic systems. Provide totaling water meter on water fill makeup line.

H. Check expansion tanks to determine that they are not air bound and that the system is completely full of water or glycol solution.

3.6 EQUIPMENT DRAINS AND OVERFLOW

A. Piping material shall be suitable for type and temperature of drainage and location of equipment. Size piping per manufacturer's requirements and as indicated.

B. Cooling coil condensate drainage shall be copper pipe. Condensate drain piping size (unless indicated otherwise):
1. Air Handling Units and Rooftop Units:
   a. Less than 30 tons: 1 1/4"
   b. 31 - 50 tons: 1 1/2"
   c. 51 - 150 tons: 2"
2. Terminal Cooling, Fan Coil, Blower Coil and Furnaces:
   a. 0 - 5 tons: 3/4"
   b. 6 - 20 tons: 1"

C. Route drains and overflows to nearest floor drain unless shown otherwise. Slope piping to drain at 1/8 inch per foot. Avoid crossing walking paths in mechanical rooms.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in hydronic, steam and condensate, and refrigerant piping systems.

B. Install control valves and accessories in accessible locations close to connected equipment.

C. When control valve sizes are smaller than indicated pipe or equipment connection size, provide eccentric reducers on inlet and outlet of control valve.

D. When coil banks are comprised of multiple coils, size individual coil supply and return piping connections same as indicated. Provide reducers to manufacturer's provided coil connections.

E. Install piping adjacent to coils to allow service and maintenance.

F. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

G. Provide bypass piping with globe valve around control valve as indicated. If multiple, parallel control valves are installed, only one bypass is required.

H. Provide ports for pressure and temperature gages at coil inlet connections.+

I. Connect supply and return hydronic piping to air terminal reheat coil with unions and shutoff valves and hose kits. Hose kit size shall be the full line size as the branch runout indicated. Provide reducer at reheat coil connection.

J. Connect condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Provide cleanouts in piping at changes of direction.

3.8 CHEMICAL TREATMENT

A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
   1. Copper: 0.
   2. pH: 10 maximum.

B. Provide bypass chemical feeder on each closed system.

C. Fill system and perform initial chemical treatment.

3.9 HEAT PUMP, RADIANT HEAT, AND SNOW MELT SYSTEM

A. Food grade propylene glycol required for ground coupled systems.

B. Fill heat pump system with inhibited, FDA approved, food grade propoylene glycol/water solution to provide freeze protection to -20 deg F.

C. System shall be cleaned as required by the chemical manufacturer.

D. Dilution water shall be distilled or deionized unless approved otherwise by the chemical manufacturer.

3.10 MECHANICAL GROOVED COUPLING REQUIREMENTS

A. Grooving tools shall be manufactured and supplied by the manufacturer of the couplings. Use roll sets or cut groovers compatible with the pipe material and wall thickness per manufacturer's installation instructions.

B. Factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation. Contractor shall remove and replace any improperly installed products.

3.11 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Provide blinds in flanged joints to isolate equipment.
5. Provide safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Provide relief valve set at pressure no more than 1/3 higher than test pressure to protect against damage by expansion of liquid or other source of overpressure during the test.
3. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
4. Check expansion tanks to determine that they are not air bound and that system is full of water.
5. Subject piping system to a hydrostatic test pressure which, at every point in the system, is not less than 1-1/2 times the design pressure assuming 125 psi minimum design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve or component on the system under the test.
6. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
7. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
8. Prepare written report of testing.

3.12 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:
1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

3.13 CLEANING OF PIPING

A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

3.14 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   5. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Steel Piping.
   1. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   2. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   3. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   4. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   5. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   6. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   7. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
   8. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
   9. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
   10. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.

C. Hanger Spacing for Plastic Piping.
   1. Per piping manufacturer's requirements and recommendations.

END OF SECTION

SECTION 23 2114

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Suction diffusers.

F. Pump connectors.

G. Combination pump discharge valves.

H. Pressure-temperature test plugs.

I. Balancing valves.

J. Automatic flow control valves.

K. Terminal equipment hose kits.

L. Relief valves.

M. Pressure reducing valves.

1.2 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

1.3 SUBMITTALS

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

B. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Manufacturer's qualification statement.

E. Project Record Documents: Record actual locations of flow controls.

F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 DIAPHRAGM/BLADDER-TYPE EXPANSION TANKS

A. Manufacturers:
1. American Wheatley: americanwheatley.com.
2. Amtrol Inc: www.amtrol.com/#sle.
3. Armstrong Pumps, Inc.
4. ITT Bell & Gossett: www.bellgossett.com.
5. Grundfos.
6. Taco, Inc: www.taco-hvac.com/#sle.
7. Wessels Company.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm sealed into tank, and steel support stand.

C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
3. Nexus Valve, Inc: www.nexusvalve.com/#sle.

4. Taco, Inc: www.taco-hvac.com/#sle.

B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. High Capacity Float Type:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Hygroscopic Air Vent:
1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

E. Maximum Fluid Pressure: 150 psi.

F. Maximum Fluid Temperature: 250 degrees F.

2.3 AIR SEPARATORS

A. In-line Air Separators:
1. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure.
2. Maximum Allowable Service Temperature: 450 degrees F.
3. Accessories: Provide epoxy coating finish, drain ball valve, and removable strainer.

B. Tangential Air Separators:
1. Manufacturers:
a. American Wheatley: americanwheatley.com.
b. Amtrol Inc[<>]: www.amtrol.com.
c. Armstrong International, Inc: www.armstronginternational.com/#sle.
d. Grundfos.
e. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
f. Taco, Inc: www.taco-hvac.com/#sle.
g. Wessels Company.
2. Primed steel body, tested and stamped in accordance with ASME BPVC-VIII-1 with integral bronze strainer, tangential flanged inlet and outlet connections, and internal stainless steel air collector tube.
3. Accessories: Provide removable strainer.

C. Coalescing Air/Dirt Separators:
1. Manufacturers:
a. American Wheatley: americanwheatley.com.
b. Amtrol Inc[<>]: www.amtrol.com.
c. Armstrong International, Inc: www.armstronginternational.com/#sle.

d. Grundfos.
e. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
f. Nexus Valve, Inc: www.nexusvalve.com/#sle.
g. Spirotherm, Inc: www.spirotherm.com.
h. Taco, Inc: www.taco-hvac.com/#sle.
i. Wessels Company.

2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1 for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions.
3. Manufactured with a removable cover to facilitate removal, inspection, and cleaning of the coalescing devices.
4. The entire basket shall be constructed of stainless steel.
5. The unit shall be 100% efficient at removing dirt down to 90 microns in 100 passes or less.
6. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
7. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
8. Conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. The air vent shall be able to be closed to allow flushing and purging of dirt via side port without dirt passing through vent on initial system fill.
9. End Connections: Class 150 flanged for 2-1/2 inch and larger otherwise threaded.
10. Inlet and outlet connections to be inline with piping system.
11. Blowdown Connection: Threaded.
12. A blow down valve shall be provided by the unit manufacturer on the bottom of each unit to allow blow down and cleaning.
13. A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and removal of the floating impurities from the air system interface within the separator.
14. Size: Match system flow capacity.
15. Maximum Fluid Service Pressure: 150 psi.
16. Maximum Fluid Service Temperature: 250 degrees F.
17. Maximum entering velocity: 10 feet per second.
18. Maximum water pressure drop shall not exceed 7 feet TDH.

2.4 BUFFER TANKS

A. Manufacturers:
1. Amtrol Inc: www.amtrol.com.
2. Armstrong Pumps, Inc.
3. American Wheatley
4. Grundfos.
5. ITT Bell & Gossett: www.bellgossett.com.
6. Taco, Inc: www.taco-hvac.com.

7. Wessels Company.

B. Tank: Fabricated steel tank; tested and stamped; for 150 psi operating pressure and 270 degrees F maximum operating temperature; subject to the requirements of the application and the manufacturer's standard maximum operating conditions.

C. Construction: Steel, constructed with nontoxic welded joints, for 125-psig working pressure.

D. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.
1. NPS 2 and Smaller: ASME B1.20.1, with female thread.
2. NPS 2-1/2 and Larger: ASME B16.5, flanged.

E. Tapping Locations:
1. Chilled Water; 2 port, low with internal baffle.
2. Heating Water; 2 or 4 port, staggered flows.

F. Specialties and Accessories: Include tappings in tank and the following:
1. Chilled water internal baffle.
2. Air vent.
3. Drain outlet.
4. Thermometer.

G. Horizontal Tank Supports: Factory-fabricated steel saddles, welded to tank before testing and labeling.

H. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.

I. Insulation: Factory-installed, fiberglass or polyurethane foam; surrounding entire tank except connections and other openings; suitable for tank operating temperature; and complying with ASHRAE/IESNA 90.1.

J. Exterior Coating: Manufacturer's standard enamel paint.

2.5 STRAINERS

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC: www.wheatleyhvac.com/#sle.
2. Armstrong International, Inc: www.armstronginternational.com/#sle.
3. Crane Co.; Crane Valve Group: www.cranevalve.com.
4. Flexicraft Industries: www.flexicraft.com/#sle.
5. Green Country Filtration: greencountryfiltration.com.
6. Nexus Valve, Inc: www.nexusvalve.com/#sle.
7. Hammond Valve: www.hammondvalve.com.
8. The Metraflex Company: www.metraflex.com/#sle.
9. Milwaukee Valve Company: www.milwaukeevalve.com.
10. Mueller Co.: www.muellercompany.com.

11. Nexus Valve.
12. Nibco Inc.: www.nibco.com.
13. Powell: www.powellvalves.com.
14. Stockham: www.stockham.com.

B. Size 2 inch and Under:
1. Class 125, screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
1. Provide Class 250, flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch or 3/64 inch stainless steel perforated screen.

D. Basket Strainers, Size 5 inch and Larger: 125-psig working pressure; high-tensile cast-iron body, ASTM A 126, Class B, flanged-end connections, bolted cover, 1/8 inch, perforated stainless-steel basket, floor stand and bottom drain connection.

2.6 PUMP SUCTION DIFFUSERS

A. Furnished by the pump manufacturer with flow charateristics to match pump design.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.7 COMBINATION (TRIPLE/MULTI-DUTY) VALVES

A. Furnished by the pump manufacturer with flow charateristics to match pump design.

B. Located on pump discharge.

C. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, isolation valve, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

D. Triple-Duty Globe Type: Flanged cast-iron angle pattern body with bolt-on bonnet, position indicator, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, metering connectors, flow shutoff mechanism, and adjustable flow handle.

2.8 PRESSURE-TEMPERATURE TEST PLUGS (PTT)

A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

B. Application: Use extended length plugs to clear insulated piping.

C. Provide test kit to include thermometer, pressure gage, access fittings, and carrying case.

2.9 MANUALLY CALIBRATED BALANCE VALVES

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC: www.wheatleyhvac.com/#sle.
2. Armstrong International, Inc: www.armstronginternational.com/#sle.
3. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
4. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
5. Nexus Valve, Inc: www.nexusvalve.com/#sle.
6. Amtrol Inc: www.amtrol.com.
7. IMI Flow Design Inc.
8. Griswold Controls.
9. Oventrop Corporation: www.oventrop.com/#sle.
10. Nexus Valve.
11. NuTech Hydronic Products.
12. Pro Hydronic Specialties
13. Taco, Inc: www.taco-hvac.com/#sle.
14. Tyco Flow Control: www.tycoflowcontrol.com.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

C. Size 2 inch and Smaller:
1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections. Blowdown/backflush drain.
2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

D. Size 2-1/2 inch and Larger:
1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections. Blowdown/backflush drain.
2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
3. Internal components construction materials consist of brass, bronze, Teflon, EPDM, NORYL, or engineered resin.

2.10 AUTOMATIC FLOW CONTROL/BALANCE VALVES

A. Manufacturers:
1. Armstrong International: www.armstronginternational.com/#sle.
2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
3. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.

4. Nexus Valve, Inc: www.nexusvalve.com/#sle.
5. Amtrol Inc: www.amtrol.com.
6. Griswold Controls.
7. IMI Flow Design Inc.
8. NuTech Hydronic Products.
9. Oventrop Corporation: www.oventrop.com/#sle.
10. Pro Hydronic Specialties
11. Taco Inc: www.taco-hvac.com/#sle.
12. Tyco Flow Control: www.tycoflowcontrol.com.
13. Victaulic Company[<>]: www.victaulic.com.

B. Provide with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

C. Construction:
1. Brass, bronze, or iron body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
2. Built-in lug-type outlet butterfly valve with 2-position handle.
3. Brass or ferrous-metal body, designed for 300 psig at 250 degrees F.

D. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

E. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.

F. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate.

2.11 TERMINAL HEATING/COOLING EQUIPMENT HOSE KIT

A. Provide hose kits on the following terminal heating/cooling equipment:
1. Water source heat pump.
a. Provide with motorized valve that stops water flow through the unit when compressor is off.
2. Hydronic equipment; Air terminal unit reheat coil, Cabinet unit heater, Chilled beam, Convector, Fan coil unit, Unit heater, and Blower coil

B. Manufacturers:
1. Flowcon: www.flowcon.com
2. IMI Flow Design Inc.
3. Griswold Controls: www.griswoldcontrols.com.
4. ITT Bell & Gossett[<>]: www.bellgossett.com.
5. Nexus Valve.
6. NuTech Hydronic Products.
7. Oventrop Corporation: www.oventrop.com/#sle.
8. Pro Hydronic Specialties
9. Taco, Inc: www.taco-hvac.com.

10. Tyco Flow Control[<>]: www.tycoflowcontrol.com.

C. Each terminal unit heating coil shall be provided with a hose kit including the following:
1. Two 24-inch long flame-retardant hoses consisting of stainless steel braid over synthetic polymer or EPDM.
a. Rated for 350 psig at 250 degrees F.
2. Supply fitting with combination ball valve, wye strainer and union with one pressure/temperature test fitting, air vent and hose end drain valve with cap and chain.
3. Return balance fitting with two pressure/temperature test fittings, air vent, union and balance valve and ball valve.

D. A calibrating flow meter shall be provided by the valve manufacturer that shall remain with the building owner after commissioning.

E. Hose kit size shall be line size as the branch runout indicated. Provide reducer at coil connection.

2.12 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.13 PRESSURE REDUCING VALVES

A. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 2113.

B. Materials of Construction:
1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

C. Connections:
1. NPT threaded: 0.50 inch or 0.75 inch.
2. Soldered: 0.50 inch.

D. Provide integral check valve and strainer.

E. Maximum Inlet Pressure: 400 psi.

F. Maximum Fluid Temperature: 180 degrees F.

G. Adjustable Pressure Range: From 10 to 45 psi, set to 25 psi.

2.14 AUTOMATIC COLD WATER FILL ASSEMBLY

A. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve.

1. Reduced pressure backflow preventer (Located no higher than 48" A.F.F.).
2. Pressure reducing valve.
3. Pressure gauge downstream of bypass.
4. 1" system quick fill valve (as indicated).

2.15 BYPASS CHEMICAL FEEDER

A. Welded steel construction, 125-psig working pressure; 2-gallon capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties and equipment in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.

E. Provide valved drain and hose connection on strainer blowdown connection.

F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

H. Support pump fittings with floor-mounted pipe and flange supports.

I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, shell and tube heat exchangers, and expansion tanks.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

L. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

M. Provide automatic cold water fill assembly on each separate hydronic system unless hydronic system contains an automatic glycol feed system.

3.2 TERMINAL EQUIPMENT CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in hydronic, steam and condensate, and refrigerant piping systems.

B. Size for supply and return piping connections shall be same as for coil and equipment connections.

C. Install control valves and accessories in accessible locations close to connected equipment.

D. When control valve sizes are smaller than indicated pipe or equipment connection size, provide eccentric reducers on inlet and outlet of control valve.

E. When coil banks are comprised of multiple coils, size individual coil supply and return piping connections same as manufacturer's provided coil connections.

F. Install piping adjacent to coils to allow service and maintenance.

G. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

H. Provide bypass piping with globe valve around control valve as indicated. If multiple, parallel control valves are installed, only one bypass is required.

I. Provide ports for pressure and temperature gages at coil inlet connections.

J. Connect supply and return hydronic piping to terminal equipment and heat pump with unions and shutoff valves and hose kits. Hose kit size shall be line size as the branch runout indicated. Provide reducer at reheat coil connection.

END OF SECTION

SECTION 23 2123

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. In-line pumps.

1.2 REFERENCE STANDARDS

A. NEMA MG 00001 - Motors and Generators.

B. UL 778 - Standard for Motor-Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

1.4 SUBMITTALS

A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Millwright's Certificate: Certify that base mounted pumps have been aligned.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Pump Seals: One for each type and size of pump.
   2. Extra Cartridges for Side-Stream Filters: One set for each filter.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

1.6 WARRANTY

A. See the Common Requirements for HVAC specification Section for requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Armstrong Fluid Technology: www.armstrongpumps.com.

B. Aurora: www.aurorapump.com.

C. Crane Pumps and Systems: www.cranepumps.com

D. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com.

E. Grundfos Pumps Corporation: www.grundfos.com/#sle.

F. Paco Pumps: www.pacopumps.com

G. Patterson, A Gorman-Rupp Company: www.pattersonpumps.com

H. Peerless Pumps: www.peerlesspumps.com

I. SIHI Group: www.sterlingsihi.com.

J. Taco: www.taco-hvac.com.

2.2 GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region.

C. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

D. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Minimum Pump Efficiency Standard: DOE Test procedure HI 40.6 and must be labeled PEI (Pump Efficiency Index).

F. Minimum Quality Standard: UL 778 and ANSI/HI Pump Standards Version 2.2

G. Casings shall be flanged.

1. Threaded casings not allowed unless extra unions and fittings are provided with that pump to allow servicing.

H. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

I. Factory-assembled, tested, and cleaned; flanges, openings, or nozzles protected during shipment.

J. Balance: Rotating parts, statically and dynamically.

K. Suitable for continuous operation at 225 deg F unless noted otherwise.

L. Pump Motors: Operate at 1150 or 1750 RPM unless specified otherwise.

M. Suction and discharge gauge tap and casing, drain and vent taps.

N. Pump seals shall be serviceable without disturbing the piping connections.

O. Minimum Pressure Rating: 175 psig.

2.3 VERTICAL IN-LINE PUMPS

A. Closed-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.

B. Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.

C. Impeller: Stainless steel, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.

E. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

2.4 DOUBLE SUCTION PUMPS

A. Description: Factory-assembled and tested, centrifugal, with impeller-between-bearings, separately coupled, double-suction pump as defined in HI 14.1, HI 14.2 and HI 14.3; designed for base mounting, with pump and motor shafts horizontal or vertical as indicated.

B. Pump Construction:
1. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, and keyed to shaft.
2. Pump Shaft: Stainless steel.
3. Casing: Horizontally or radially split, cast iron, with replaceable bronze wear rings, threaded gauge tappings at inlet and outlet, drain plug at bottom of volute, mounting support, and ASME B16.1, Class [CHOICE TEXT] flanges.

4. Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR bellows and gasket.
5. Pump Bearings: Throttle bushing or grease-lubricated ball bearings in cast-iron housing with grease fittings.

C. Horizontal Shaft Coupling: Molded-rubber insert capable of absorbing vibration. Couplings to be drop-out type to allow disassembly and removal without removing pump shaft or motor, EPDM coupling sleeve for variable-speed applications.

D. Vertical Shaft Coupling: Rigid aluminum and interlocking spider capable of absorbing vibration.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 compliant; steel; removable; attached to mounting frame.

F. Pump Connection Confguration:
1. As indicated.
2. Horizontal suction and discharge.
3. Horizontal suction, vertical discharge.
4. Vertical suction and discharge.

G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36/A36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

H. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements.
1. Enclosure: Totally enclosed, fan cooled (TEFC).
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Variable-speed motor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.3 INSTALLATION

A. Piping installation requirements are specified in other sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install in accordance with manufacturer's instructions and HI 1.4 or HI 2.4.

C. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer and applicable codes.

D. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized shut-off, soft seat check valve and balancing valve on pump discharge.

E. Provide suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

F. Provide drain valve with hose end on suction side of each pump.

G. Provide straight section of pipe, 5 pipe diameters, on suction connection to pump. Suction diffusers may be used in lieu of piping or as indicated.

H. Provide flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Provide pressure gage with multiple valves connected to integral pressure gage tappings to measure pressure at suction, discharge, and strainer inlet.

J. Provide pressure/temperature test fitting (PTT) on suction and discharge connection of each pump to allow pump performance testing.

K. Provide air cock and drain connection on horizontal pump casings.

L. Lubricate pumps before start-up.

M. Ground equipment according to Section 26 0526 - Grounding and Bonding.

N. Connect wiring according to Section 26 0519 - Building Wire and Cable.

3.4 ALIGNMENT

A. Laser align pump and motor shafts and piping connections after setting on foundation and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 23 3100

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

1.2 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.
   1. Example: Apparent Thermal Conductivity (k-Value): 0.25 or 0.037.

B. Pressure - Velocity Classification for Ductwork: As defined by SMACNA Duct Construction Standards - Metal and Flexible (latest edition), and applicable codes. Pressure classification for this specification:
   1. Low Pressure: Maximum 2500 FPM velocity; maximum 2.0 inches WG positive or -2.0 inches WG negative static pressure class.
   2. Medium Pressure: Maximum 4000 FPM velocity; maximum 4 inches WG positive or -3.0 inches WG or greater negative static pressure class.
   3. High Pressure: Velocity over 4000 FPM, pressure over 4 inches WG.

C. Gauge:
   1. Steel Sheet: U.S. Standard gauge.
   2. Aluminum Sheet: Brown & Sharpe schedule.
   3. Steel Wire: Washburn & Moen gauge.

D. Concealed Insulated Surfaces: Ductwork and equipment located in walls, partitions, floors, chases, shafts, and above ceilings.

E. Exposed Insulated Surfaces: Ductwork and equipment located in mechanical rooms, tunnels and rooms without suspended ceilings.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.146 - Permit-Required Confined Spaces.

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

J. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

K. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

L. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

1.4 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Design Professional. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Size round ducts in lieu of rectangular ducts indicated in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

A. Product Data: Provide data for all duct materials, duct liner, and duct connections.

B. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for all duct system pressure classes systems.
   1. CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) scale.
      a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
      b. Duct layout indicating sizes and pressure classes.
      c. Elevations of top and bottom of ducts.
      d. Dimensions of main duct runs from building grid lines.
      e. Fittings.

f. Reinforcement and spacing.
g. Seam and joint construction.
h. Penetrations through fire-rated and other partitions.
i. Equipment installation based on equipment being used on Project.
j. Duct accessories, including access doors and panels.
k. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members, and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

D. Comply with ASHRAE and SMACNA Design Handbooks.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.8 DELIVERY, STORAGE AND HANDLING

A. Ductwork shall not be stored directly on the ground. Watermarked ductwork will not be accepted for installation.

B. Lined ductwork shall have all open ends sealed during delivery and storage periods.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Duct Shape and Material in accordance with Allowed Static Pressure Range:
   1. Round: Plus or minus 2 in-wc of galvanized steel.
   2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.

C. Duct Sealing and Leakage in accordance with Static Pressure Class:
   1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
      a. Supply Air: 1 in-wc pressure class, galvanized steel.
      b. Outside Air Intake: 1 in-wc pressure class, galvanized steel, liquid tight joints on horizontal routes.
      c. Return and Relief Air: 1 in-wc pressure class, galvanized steel.
      d. General Exhaust Air: 1 in-wc pressure class, galvanized steel.
      e. Combustion Air: 1 inch w.g. pressure class, galvanized steel.

D. Duct Fabrication Requirements:
   1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
   2. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
   3. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
   4. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
   5. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
   6. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
   7. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
   8. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use

same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, FS Type B, with G90/Z275 coating.
   1. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Water based, non-fibrated, heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
   3. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   4. Duct Sealing Rolled Sealant:
      a. Pressure sensitive, 40-year cycle, duct joint and general purpose rolled sealant. rated for use with sheet metal, duct board, flex board, PVC coated duct, and duct wrap vapor barriers.
      b. 100 percent solid elastomeric modified butyl with aluminum foil backing.
      c. Thickness: 17 Mils.
   5. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
   6. Flange and Joint Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel, threaded steel rod or steel cable with adjustable and removable locking mechanism.
   1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
   2. Strap, Rod and Cable Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and steel rod

diameters. Comply with SMACNA and manufacturer's recomendations for cable and locking mechanism sizes.

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Cable Hanger System:

1. Basis of Design: Gripple and Ductmate Clincher
2. Products shall carry a 5:1 safety factor.
3. SMACNA compliance - Tested and verified to be an acceptable hanger per the SMACNA, HVAC Duct Construction Standards.
4. UL Listing - UL 1598 luminaire fitting sizes 1 - 5, UL 2289 Conduit and Cable Hardware sizes 2, 3 and 4.
5. Housing: Type ZA2 Zinc.
6. Wedge: Sintered steel hardened to min. 56 Rockwell C.
7. Spring: 302 Stainless Steel.
8. End Cap: UV stabilised homopolymer propylene.
9. Wire Rope: Grade galvanized high tensile steel wire rope to EN12385.
10. Toggle Plate and End Stop: Zinc plated steel.
11. Stud Eyelet and Barrel End: Zinc plated steel.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.4 DUCTWORK FABRICATION

A. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation. Radius T's, bends and elbows less than 1-1/2 times width of duct on centerline are not allowed.

B. Low Pressure Ductwork: Construct all ductwork using galvanized steel except as indicated.

1. Seams and Joints: Longitudinal seams shall be grooved seams, button punch snap lock or Pittsburgh lock. Transverse joints shall be drive slip. Joints 36-inch size and larger shall be manufactured duct joining system with downset corners, no-bolt design, or SMACNA T-25 formed on flanges with corner and cleat. Contractor option on smaller sizes.

C. Branch ducts to air devices shall be bell-mouth, conical or 45 degrees to round boot type fitting as a basis. Straight tap-ins, splitter dampers, and air extractors shall not be used.

D. Duct connections to fans/air-handling units shall be designed for proper entering and leaving conditions at the fan to avoid any adverse system effect fan losses.

2.5 MANUFACTURED DUCTWORK, FITTINGS AND CONNECTORS

A. Manufacturers:
1. Ductmate Industries, Inc.:
2. Eastern Sheet Metal.
3. KB Duct
4. LaPine Metal Products
5. Lewis and Lambert
6. Linx Industries
7. Metal-Fab, Inc.: www.mtlfab.com.
8. MKT Metal Manufacturing: www.mktduct.com.
9. Nexus Inc.
10. Norlock
11. SEMCO Incorporated: www.semcoinc.com.
12. S.E.T. Duct Manufacturing
13. Sheet Metal Connectors.
14. Spiral Pipe of Texas.
15. United McGill Corp.: www.unitedmcgill.com.
16. Ward Industries, Inc.

B. Material Requirements:
1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
2. Ungalvanized Steel: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
3. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.
4. Stainless Steel: ASTM A666, Type 304.

C. Round Metal Ducts:
1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
2. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).

D. Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.

E. Connectors, Fittings, Sealants, and Miscellaneous:
1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
    a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
    b. VOC Content: Not more than 250 g/L, excluding water.
    c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

d. For Use with Flexible Ducts: UL labeled.

4. Gasket Tape:
   a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.

2.6 DUCT LINER

A. Refer to Section 23 0713 - Duct Insulation.

PART 3 EXECUTION

3.1 PRE-INSTALLATION

A. Field measure to determine exact conditions.

B. Provide duct opening closure film on all ductwork until final connections are completed.

C. Verify location of air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to reflected ceiling plans, finish schedule, material finish specification, and shop drawings.

D. Openings required for ductwork through structural elements in new construction shall be coordinated with the General Contractor. Shop drawings locating such openings shall be prepared in ample time to meet the construction schedule.

E. Coordinate and install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install ducts with a clearance of 2 inches, plus allowance for insulation thickness.

F. Coordination Process and Drawings:
   1. Provide coordination in determining adequate clearance and space requirements for mechanical equipment and electrical equipment and other items/equipment in the project. The Design Professional reserves the right to determine space priority of equipment in the event of interference between pieces of equipment, piping, conduit, ducts and equipment of the trades. The Design Professional will only review conflicts and given an opinion but will not perform as a coordinator.
      a. The coordination process shall utilize the actual equipment being provided. Refer to manufacturer's data for physical size, access and maintenance requirements. Provide all code required clearances.
   2. Provide coordination drawings indicating structural components, reflected ceiling layout, mechanical items, electrical items, and pneumatic tube systems. Indicate on the coordination drawings where components will be installed and how the service access area to such items shall be maintained, Illustrate items requiring access for maintenance or adjustment.
   3. The Contractor will not be allowed any time extensions for participation in the coordination drawing process. The Contractor will not be allowed any contract cost extra for any additional fittings, rerouting or changes of duct size to

equivalent sizes to those shown on the drawings that may be determined necessary through the coordination drawing process.

4. Equipment layout and all system layouts shall confirm adequate clearances for installation, operation, maintenance, and code-required clearances from the structure or other equipment and systems. Provide offsets and elevation changes in piping, conduit and ductwork as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.
5. Deviations from the contract documents that are necessary for overall system installation and coordination shall be brought to the attention of the Design Professional.
6. Access panels shall occur only in gypsum wallboard or plaster ceilings where indicated on the drawings. Access to mechanical and electrical items shall be through accessible acoustical ceiling areas. Additional access panels will not be allowed without written approval from the Design Professional at the coordination drawing stage and only after alternatives are reviewed. Layout changes shall be made to avoid additional access panels. If additional access panels are required, they shall be provided at no additional cost to the Owner.
7. Soffit penetrations and light alcoves shall be fully coordinated with hanging devices, studs, fire/smoke ratings, and structural support requirements.
8. Drawings shall be prepared at 1/4 inch = 1 foot, 0 inches (minimum).
    a. Coordination participants shall provide equipment installation and clearance requirements. This information shall be indicated on the coordination drawings.
    b. Coordination drawings shall indicate the following major system components (including insulation, hub or connection widths with verification of turning radius):
        1) All general construction components
        2) Roof drain leaders
        3) Large waste piping
        4) Sprinkler mains
        5) Equipment located above the ceiling
        6) Heating hot water piping
        7) Chilled water piping
        8) Conduit runs 2 inches and larger
        9) Cable tray
        10) Bus duct
        11) Recessed light fixtures
        12) Building wiring or cable trays
        13) Ceiling heights as shown in contract documents and thickness of system
        14) Soffits (including framing of supports)
        15) Access points and clearances required
        16) Access panels
        17) Valves
        18) Dampers
        19) Coils

20) Ductwork
21) Fire-rated wall, partition, and floor penetrations
22) Space allotted for future utilities
23) Equipment in mechanical and electrical spaces

c. Information shall be delineated to indicate distances from column centerlines, pipe/equipment size, and distance from finished floor to bottom of pipe/equipment and hangers.

9. The Contractor and subcontractors responsible for items of work located in or above ceilings shall participate in the coordination drawing process. Participation is mandatory. If the Contractor or subcontractor fails to participate in the coordination drawing process, the Owner reserves the right to do the following:
   a. Stop construction progress payments for work performed by the Contractor. Payments will be reinstated only after the Contractor or subcontractor resumes participation in the coordination drawing process.
   b. Require the relocation and resizing of components as necessary to ensure components will be installed as intended. In the event the Contractor did not participate in the coordination process, the Contractor will not be entitled to contract cost increases or time extensions due to Owner-initiated changes in the work.
   c. The Contractor shall be held responsible for unnecessary rework that is attributable to failure to participate in the coordination process.
10. The coordination drawings shall be submitted to the Design Professional and Owner's representative for review. The submitted coordination drawings shall indicate which contractors participated in the process and where conflicts appear to occur even after the priority ranking of utility routing has been utilized. In the event that conflicts require input from the Design Professional, recommended solutions will be provided with the coordination drawings for review by the Design Professional. The Design Professional will review and return an opinion to the contractors for implementation. All contractors shall agree to the final coordinated layout by signing off on the coordination drawings before any construction can begin.
11. Maintain an updated set of coordination drawings at the job site reflecting changes, modifications and adjustments. Changes shall be reflected and sets or new sheets reissued to the Design Professional and the Owner for review on a monthly basis with changes “clouded” and brought to the attention of the Design Professional and the Owner.
12. When a change order request is issued, the affected subcontractors shall review the coordination drawings and bring to the attention of the Contractor and the Design Professional revisions necessary to the work of others not directly affected by the change order.
13. Contractors that fail to cooperate in the coordination drawing effort shall be responsible for all costs incurred for adjustments to the work made necessary to accommodate installations. Provide adequate clearance and access through accessible ceilings. Conflicts that result after the coordination drawings are signed off will be the responsibility of the Contractor or subcontractor who did not properly identify their work or installed the work improperly.

3.2 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).
   1. Hanging, Sealing and Supporting:
      a. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
      b. Support vertical ducts at a maximum interval of 16 feet and at each floor.
      c. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
      d. Install concrete inserts before placing concrete.
      e. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
         1) Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
      f. Seal ducts before external insulation is applied.

B. Install products following the manufacturer's instructions.

C. Comply with safety standards NFPA 90A and NFPA 90B.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Keep openings covered until ready for continuing duct run or final connections. Clean all unlined supply air ductwork during installation by swabbing with a non-toxic, non-flammable cleaning agent.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Provide volume dampers in all branch take-offs connecting to diffusers, registers and grilles, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
   1. Provide access door or remote damper operator to adjust dampers.
   2. Registers and diffusers with dampers shall be used only if devices are installed directly on the trunk duct.

G. Provide volume dampers in all duct systems where indicated and as required to perform complete system test and balance. Coordinate all volume damper locations with the test and balance contractor.
   1. Provide access door or remote damper operator to adjust dampers.

H. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

I. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

J. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

K. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.

L. Use double nuts and flat washer on threaded rod supports.

M. Fire Partitions: Provide firestopping sealing. See Section 07 8400.

N. Penetrations:
1. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Oscverlap opening on four sides by at least 1-1/2 inches.
2. Provide sleeves at all duct penetrations through walls, floors and roofs. Openings through sound-rated partitions shall have annular space stuffed with fiberglass insulation for full thickness of wall.
3. Provide closure flanges around exposed ductwork at wall and ceiling penetrations, 1-1/4 inches wide minimum.

O. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

P. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

Q. Prevent passage of unfiltered air around filters with felt, rubber, neoprene gaskets, or other approved safing material.

R. Provide flexible connect between ductwork and all moving equipment.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices.

B. Duct access doors.

C. Duct test holes.

D. Fire dampers.

E. Flexible duct connectors.

F. Volume control dampers.

G. Low leakage (Class 1A) control dampers.

H. Miscellaneous Products:
1. Internal strut end plugs.
2. Duct opening closure film.

I. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

B. Shop Drawings: Indicate for shop and field fabricated assemblies including volume control dampers and duct access doors.
1. Special fittings.
2. Motorized-control damper installations.
3. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
4. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer's Installation Instructions: Provide instructions for fire dampers, combination fire and smoke dampers, and smoke dampers.

D. Project Record Drawings: Record actual locations of access doors and test holes.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Fusible Links: One of each type and size.

F. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Access Doors, Devices and Accessories:
1. Acudor Products Inc: www.acudor.com.
2. Carlisle HVAC Products: www.carlislehvac.com/sle.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing: www.elgenmfg.com.
5. Flexmaster U.S.A., Inc.
6. Greenheck: www.greenheck.com
7. Krueger: www.krueger-hvac.com.
8. Lloyd Industries, Inc.: www.firedamper.com.
9. Nailor Industries Inc: www.nailor.com.
10. PCI Industries, Inc; Pottorff Brand [<>]: www.portorff.com.
11. Ruskin Company: www.ruskin.com.
12. SEMCO Incorporated: www.semcohvac.com.
13. Titus: www.titus-hvac.com.
14. United Enertech
15. Ventfabrics, Inc.
16. Vent Products Company, Inc.
17. Young Regulator Co
18. CL Ward Industries, Inc: www.clward.com/.

B. Dampers:
1. Air Balance, Inc.
2. Greenheck: www.greenheck.com
3. Louvers & Dampers, Inc: www.louvers-dampers.com.
4. Lloyd Industries, Inc.[<>]: www.firedamper.com.
5. Nailor Industries Inc[<>]: www.nailor.com.
6. NCA Manufacturing, Inc.: www.ncamfg.com
7. Pottorff/PCI Industries, Inc; Pottorff Brand : www.portorff.com.
8. Rossi: www.rossihardware.com
9. Ruskin Company: www.ruskin.com.
10. Tamco
11. United Enertech: www.unitedenertech.com/#sle.
12. Vent Products Company, Inc.

13. CL Ward Industries, Inc: www.clward.com/.

C. See paragraphs below for additional manufacturers.

2.2 SHEET METAL MATERIALS

A. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

B. Stainless Steel: ASTM A 480/A 480M.

C. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 AIR TURNING DEVICES

A. Multi-blade device with blades aligned in short dimension; steel construction; with individually and mounting straps.

2.4 BACKDRAFT DAMPERS - METAL

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

B. Frame: 0.052-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

C. Blades: 0.025-inch-thick, roll-formed aluminum.

D. Blade Seals: Vinyl.

E. Blade Axles: Nonferrous.

F. Bearings: Synthetic.

G. Tie Bars and Brackets: Galvanized steel.

H. Spring Assisst: Adjustable tension for use in vertical up air flow or low pressure relief applications.

I. Counter-Balanced: Adjustable for use in vertical down air flow applications.

2.5 DUCT ACCESS DOORS

A. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.
   5. Access doors shall be provided with sash locks only when clearance space does not allow a door swing.

B. Access doors with sheet metal screw fasteners are not acceptable.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with foam insulation fill and 1-inch thickness.
   1. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
   1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.6 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Frame Type B (Blades out of the airstream).

C. Type: Dynamic fire dampers.
   1. Differential Pressure (Dynamic):
      a. Dampers shall have a minimum UL 555 differential pressure rating of 4 in. wg.
   2. Velocity (Dynamic):

a. Dampers shall have a minimum UL 555 velocity rating of 2000 fpm.

D. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap,stainless steel closure spring, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
1. Boot Fitting: Factory-provided el type (90 degree). Include field-provided collar.
2. Box Fitting: Factory-provided 26 gauge, 0.0179 inch with field-provided collar.
3. Rated for three hour service in compliance with UL 555C.

E. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.

F. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.

G. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

H. Fusible Links: UL 33, separate at 165 degrees F with adjustable link straps for combination fire/balancing dampers.

I. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

J. Fire Rating: 1-1/2 hours.

K. Mounting Sleeve: Factory- or field-installed, breakaway type, galvanized sheet steel.
1. Minimum Thickness: As required by UL. Minimum length, 12 inches.

2.8 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Maximum Installed Length: 14 inch.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 degrees F.

2.9 VOLUME CONTROL/BALANCING DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gauge, 0.0239 inch, minimum.

C. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
   1. Blade: 18 gauge, 0.0478 inch, minimum.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

E. Quadrants:
   1. Provide positive-locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.10 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.

B. Frame:
   1. Material: 20-gauge galvanized steel.
   2. Free-area: Single cross section.
   3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.

C. Blade:
   1. Type: Multi-blade such as V or 3V for low to medium pressure.
   2. Maximum Individual Blade Height: 8 inches.
   3. Material: 12-gauge galvanized steel.
   4. Authority: Opposed type, 5 to 50 percent (typically 10 percent).

D. Insulation: Water-resistant sound absorbing material.

E. Temperature Service Range: Minus 25 to 185 degrees F.

F. Other Requirements:
   1. Paint Finish: Standard.
   2. Sleeve or Flange: Factory-mounted standard.

2.11 MISCELLANEOUS PRODUCTS

A. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.

B. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
   1. Thickness: 2 mils.
   2. High tack water based adhesive.
   3. UV stable light blue color.
   4. Elongation Before Break: 325 percent, minimum.

C. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 12 x 12 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

E. Provide duct access doors to all internal devices requiring inspection for maintenance, including, but not limited to fire dampers, combination fire/smoke dampers, duct smoke

detectors, coils (entering side), humidifiers (with window) and similar devices. Coordinate location devices in access door to allow proper access to equipment once project has been completed. Duct access doors shall be square and sized 2 inches less than the width of the duct. Maximum door size shall be 18 inches. If required, provide multiple doors for adequate access to equipment.

F. Provide duct test holes where indicated and required for testing and balancing purposes.

G. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, where required by codes, and where required by authorities having jurisdiction.

H. Demonstrate re-setting of fire dampers to Owner's representative.

I. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

J. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

L. Provide volume control (balancing) dampers on duct take-off to all air inlets and outlets, diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
   1. Provide access door or remote damper operator to adjust dampers. Registers and diffusers with dampers shall be used only if devices are installed directly on the trunk duct.

M. Provide volume control (balancing) dampers in all duct systems where indicated and required to perform complete system test and balance. Coordinate all volume damper locations with the test and balance contractor.
   1. Provide access door or remote damper operator to adjust dampers. Registers and diffusers with dampers shall be used only if devices are installed directly on the trunk duct.

N. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

O. Label all duct access doors.

P. Provide flexible connections to motor driven air moving equipment. Secure fabric to duct or fan collar with 3/16-inch rivets spaced not more than 5 inches o.c. Provide thrust restraints and other devices so that connections are not in tension with equipment running or off. Air handling units with internally isolated fans need not have flexible connections.

Q. Volume dampers located above inaccessible ceilings shall be controlled by remote volume damper position controls.

R. Provide turning vanes in all mitered duct turns.

3.3 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

3.4 DEMONSTRATION

A. Demonstrate the following to the owner's representative and maintenance personnel:
   1. Access to all fire, smoke and combination fire/smoke dampers.
   2. Access to all volume damper position controls.
   3. Access to control damper actuators.

END OF SECTION

SECTION 23 3423

HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall exhausters.

PART 2 PRODUCTS

2.1 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.2 WALL EXHAUSTERS

A. Manufacturers:
1. Carnes, a division of Carnes Company Inc; _____: www.carnes.com/#sle.
2. Greenheck Fan Corporation; _____: www.greenheck.com/#sle.
3. Patterson Fan Company, Inc; _____: www.pattersonfan.com/#sle.
4. Twin City Fan & Blower; WPB: www.tcf.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.

C. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor, and wall mounted multiple speed switch or solid-state speed controller.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

E. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm can be reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION

SECTION 23 3600

AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single-duct terminal units.
   1. Variable-volume units.

B. Fan-powered units.

1.2 SUBMITTALS

A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

B. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
   1. Include schedules listing discharge and radiated sound power level for each of the second through sixth-octave bands at inlet static pressures of 1 to 4 in-wc.

C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.4 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide one year manufacturer warranty for fan powered air terminal units.

1.5 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
   1. Coordinate maintenace clearance requirements of all terminal unit controls components prior to ordering and submitting units for review.

PART 2 PRODUCTS

2.1 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.2 MANUFACTURERS

A. Anemostat.

B. Carnes Company: www.carnes.com.

C. Carrier Corp.

D. Environmental Technologies, Inc.; Enviro-Air Div.

E. Greenheck; www.greenheck.com.

F. Johnson Controls, Inc: www.johnsoncontrols.com.

G. Krueger; www.krueger-hvac.com

H. Metalaire Inc.; Metal Industries Inc.

I. Nailor Industries Inc.: www.nailor.com.

J. Price Industries.; www.priceindustries.com.

K. Titus; www.titus-hvac.com.

L. Trane Inc: www.trane.com.

M. Tuttle & Bailey.

N. Siemens.

2.3 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, room number served, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

2.4 GENERAL

A. Basic Assembly:
1. Factory insulated casing, reheat coil, access door and sound attenuating sections.
2. Plenum Air Inlets: Round stub connections for duct attachment.
3. Plenum Air Outlets: S slip and drive connections.
4. Access: Insulated, removable panels or doors for access to heating coils, dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Heating coil access doors located upstream of heating coil for coil cleaning purposes.

B. Basic Unit:
1. Configuration: Air volume damper assembly inside unit casing.
2. Locate control components inside protective metal enclosure.
3. Heating coil on fan powered units shall be located on the supply air discharge outlet.

2.5 SINGLE-DUCT, VARIABLE-VOLUME UNITS

A. Acoustic Performance Requirements:
1. Sound ratings of air distribution assemblies: Not to exceed 30 NC at a .50" static pressure drop across the unit, and the downstream static pressure of .25".

B. General:
1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
3. Basic Unit:
a. Mount damper operator to position damper normally open.

C. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch galvanized steel.
a. Casing leakage to meet ASHRAE Std 130.
2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, with slip-and-drive connections.
4. Acceptable Liners:
a. 3/4 inch thick adhesive of polyurethane or neoprene foam complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84.
b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D. Sound Attenuator:
1. Provide if required to meet scheduled acoustical performance requirements.
2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
3. At 2000 fpm inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 in-wc.

E. Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak damper blades for tight airflow shutoff.

F. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
3. Coil leak tested to minimum 350 psig.
4. Base performance data on tests run in accordance with AHRI 410and units to bear AHRI 410 label.

G. Controls:
1. DDC (Direct-Digital Controls):
a. See Section 23 0923.
2. Airflow Cross: Differential pressure airflow device measuring total, static, and wake pressures.
a. Flow cross compatible accuracy: Plus/minus five percent throughout terminal operating range.

2.6 FAN-POWERED SERIES UNITS

A. General:

1. Factory-assembled and wired, AHRI 880 (I-P) rated, horizontal fan-powered terminal unit with blower, blower motor, mixing plenum, and primary air damper contained in a single unit housing.
2. Basic Unit:
    a. Configuration: Air volume damper assembly and fan in parallel arrangement inside unit casing.
    b. Mount primary air damper operator to position damper normally open.
    c. Mount outdoor air damper operator to position damper normally closed.

B. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch galvanized steel.
2. Primary Air Inlet Collar: Suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, suitable for flanged duct connection.
4. Plenum/Attenuator Inlet: Angular filter rack with disposable filters.
    a. 2 inch thick disposable fiberglass filters.
    b. Minimum Efficiency Reporting Value (MERV): 8 ____, when tested in accordance with ASHRAE 52.2.
5. Acceptable Liners:
    a. 3/4 inch thick adhesive of polyurethane or neoprene foam complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84.
6. Inlet Sound Attenuator:
    a. Provide to meet scheduled acoustical performance requirements.
    b. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
7. Discharge Sound Attenuator:
    a. Provide to meet scheduled acoustical performance requirements.
    b. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.

C. Primary Air Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid shaft rotating in bearings.
2. Provide indicator on damper shaft or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak (2 percent) damper blades for tight airflow shutoff.

D. Fan(s): Forward curved, centrifugal type.
1. Fan Motor:
    a. ECM (Electrically Commutated Motor):
        1) Brushless DC controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator.
        2) Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
        3) Designed to maintain 70 percent efficiency over the entire operating range.

b. Fan motor shaft directly connected to fan and isolated from unit casing to prevent transmission of vibration.

E. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal unit with flanged discharge for attachment to downstream ductwork.
2. Heavy-gauge aluminum fins, mechanically bonded to tubes.
3. Copper Tubes: 0.016 inch minimum wall thickness with male solder header connections.
4. Coil leak tested to minimum 305 psig.
5. Base performance data on tests run in accordance with AHRI 410.
6. Locate hot water heating coil on the induction/return air inlet on parallel fan units.

F. Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of NFPA 70.

G. Wiring:
1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
2. Factory mount transformer for control voltage on electric and electronic control units. Provide terminal strip in control box for field wiring of thermostat and power source.
3. Wiring Terminations: Wire fan and controls to terminal strip. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
4. Disconnect Switch: Factory mount unfused disconnect switch in control panel.

H. Controls:
1. DDC (Direct-Digital Controls):
2. Airflow Cross: Differential pressure airflow device measuring total, static, and wake pressures.
a. Flow cross compatible accuracy: Plus/minus five percent throughout terminal operating range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Provide a minimum of 18" clearance to all servicable components.

B. Provide all code required service clearances.

C. Provide code required access clearances, 36" minimum, to all electrical components and panels.

D. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

E. Coordinate locations of control components, heating coil piping and access door or panels with installation space available. Adjusting indicated location of terminal unit and heating coil piping is acceptable if necessary to acheive required service clearances.

F. Provide 24" x 24" ceiling access doors at each unit or locate units above easily removable ceiling components.

G. Support units individually from structure with wire rope complying with SMACNA (SRM).

H. Support fan-powered units from structure vibration isolating hangers per manufacturer's recommendations.

I. Embed anchors in concrete in accordance with ASTM E488/E488M.

J. Do not support units from adjacent ductwork.

K. Connect to ductwork in accordance with Section 23 3100.

L. Provide minimum of 5 ft of 1 inch thick lined ductwork downstream of units.

M. Verify that electric power is available and of the correct characteristics.

N. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

O. Provide 10" x 8" (min.) access doors upstream of reheat coils, as indicated, for cleaning and service.

3.3 CONNECTIONS

A. Provide straight run of inlet supply ductwork as required by manufacturer.

B. Provide flexible duct connection on discharge (supply) air connection to fan powered terminal units as indicated.

C. Piping installation requirements are specified in other sections. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Install piping adjacent to air terminal units to allow service and maintenance.

E. Hot-Water Piping: In addition to requirements in Section 23 2113 - Hydronic Piping, connect heating coils to supply with shutoff valve, strainer, PTT and union or flange; and to return with PTT, control valve, balancing valve and union or flange.

F. Connect ductwork according to 23 3100 - HVAC Ducts and Casings. Prvide inlet and outlet duct connections as recommended by air terminal unit manufacturer to achieve proper performance.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.5 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow.

3.6 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to inspect and instruct field-assembled components and equipment installation, including connections. Report results in writing.
   1. Complete installation and startup checks according to manufacturer's written instructions and do the following:
      a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
      b. Verify that controls and control enclosure are accessible.
      c. Verify that control connections are complete.
      d. Verify that nameplate and identification tag are visible.
      e. Verify that controls respond to inputs as specified.
   2. Leak Test:
      a. After installation, fill water coils and test for leaks.
      b. Repair leaks and retest until no leaks exist.
   3. Operational Test:
      a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
      b. Test and adjust controls and safeties.
      c. Replace damaged and malfunctioning controls and other equipment.
      d. Remove and replace malfunctioning units and retest as specified above.

3.7 CLEANING

A. Vacuum clean coils and inside of units.

END OF SECTION

SECTION 23 3700

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers:

B. Registers/grilles:

C. Induction difusers.

D. Door grilles.

E. Louvers:

F. Roof hoods.

G. Goosenecks.

H. Gravity ventilators.

1.2 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.

B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

F. SMACNA (ASMM) - Architectural Sheet Metal Manual.

G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

1.3 SUBMITTALS

A. Specification Compliance Review.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Product Data: For each model indicated, include the following:
   1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
   4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

D. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

E. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

F. Project Record Documents: Record actual locations of air outlets and inlets.

1.4 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated.
   1. Do not modify intended aesthetic effects, as judged soley by Design Professional, except with Design Professional's approval. If modifications are proposed, submit comprehensive explanatory data to Design Professional for review.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. American Louver Company: www.americanlouver.com.

B. Carnes, a division of Carnes Company Inc: www.carnes.com/sle.

C. Dadanco: www.dadanco.com

D. Krueger: www.krueger-hvac.com.

E. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.

F. NCA

G. Nailor Industries.

H. Price Industries: www.price-hvac.com.

I. Ruskin Company[<>]: www.ruskin.com/#sle.

J. Titus: www.titus-hvac.com.

K. Tuttle and Bailey: www.tuttleandbailey.com/sle.

L. Trox Technik.

2.2 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.3 MANUFACTURED UNITS

A. General: Sizes, types and capacities shall be as indicated.

B. Ceiling and wall frame types and dimensions shall be verified from architectural drawings.

C. Verify ceiling frame and panel style and dimension with reflected ceiling plan, room finish schedule and material type.

D. If final diffusers or registers have a higher sound level than those specified or if dimensions are not compatible with finished walls, ceilings, floors or architectural air cabinets (millwork), installed diffusers and registers shall be replaced at the Contractor's expense.

E. Outlets and inlets shall be factory baked enamel finished with color selected by Design Professional unless indicated.

2.4 LOUVERS

A. Manufacturers:
1. Air Balance.
2. Airline.
3. American Warming and Ventilating.
4. Arrow.
5. Cesco.
6. Greenheck.
7. Louvers & Dampers, Inc.
8. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
9. Pottorff.

10. Ruskin Company: www.ruskin.com/#sle.
11. Nailor Industries, United Enertech.
12. Ruskin.
13. Safe Air - Dowco.
14. Tamco
15. Vent Products.

B. General: Louvers shall be AMCA Standard 500 performance rated and licensed. Louver frame shall have hidden mullions unless indicated. Vertical mullions for blade supports shall be placed at a maximum spacing of 4 feet. Factory assembled louver components. All welded construction. Design Load: Incorporate structural supports required to withstand wind load of 20pounds per square foot.

C. Materials:
1. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
2. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
3. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
4. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.
5. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
    a. Use types and sizes to suit unit installation conditions.
    b. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
6. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
7. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Aluminum Fabrication:
1. Frame:
    a. Material: Extruded aluminum, Alloy 6063-T5.
    b. Wall Thickness: 0.081 inch, nominal.
    c. Depth: 4 inches.
    d. Downspouts and caulking surfaces.
2. Blades:
    a. Style: Drainable.
    b. Material: Extruded aluminum, Alloy 6063-T5.
    c. Wall Thickness: 0.081 inch, nominal.
    d. Angle: 37.5 degrees.
    e. Centers: 5-3/32 inches, nominal.
3. Gutters: Drain gutter in head frame and each blade.
4. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

5. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches.
6. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.
7. Finish:
    a. Kynar 500 Fluoropolymer Coating.

E. Performance Data:
1. Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
2. Free Area: 50 percent, nominal.
3. Maximum Recommended Air Flow Thru Free Area: 875 feet per minute.
    a. Air Flow: 7,500 cubic feet per minute.
4. Maximum Pressure Drop: 0.10 inches w.g.
5. Low Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 875 feet per minute free area velocity when tested for 15 minutes.

F. Mounting: Furnish with interior flat flange for installation.

2.5 LOUVER ACCESSORIES

A. Blank-Off Panels: 0.040 aluminum sheet, factory installed with removable fasteners and neoprene gaskets.

B. Insulated Blank-Off Panels: 0.040 aluminum sheet, 1 inch aluminum skin insulated core, factory installed with removable fasteners and neoprene gaskets.

C. Hinged Frame: Continuous piano hinge.

D. Aluminum Filter Racks: Formed channel racks to accept standard thick filters. Unused bottom portion blanked off with 0.040 inch aluminum sheet.
1. Filter: 2 inch thick.

E. Bird Screen:
1. Aluminum: Aluminum, 1/2 inches by 0.063 inch, intercrimp.
2. Frame: Removable. Rewireable.

F. Extended Sills:
1. Extruded aluminum, Alloy 6063-T6. Minimum nominal thickness 0.060 inch.

G. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.

2.6 ROOF HOODS

A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).

B. Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch base and 20 gauge, 0.0359 inch hood, or aluminum, minimum 16 gauge, 0.0598 inch base and 18 gauge,

0.0598 inch hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.

C. Fabricate louver penthouses with mitered corners and reinforce with structural angles.

D. Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

E. Make hood outlet area minimum of twice throat area.

F. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Built-in cant and mounting flange.
   2. Overall Height: 18 inches.

G. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch.

H. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
   3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.

I. Color and Gloss: To be selected by Design Professional from manufacturer's standard range.

2.7 GOOSENECKS

A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.

B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Built-in cant and mounting flange.
   2. Overall Height: 18 inches.

D. Bird Screening: Galvanized-steel, 1/2-inch-square mesh, 0.041-inch wire.

E. Galvanized-Steel Sheet Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing

according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.

F. Color: To be selected by Design Professional from manufacturer's standard range.

2.8 GRAVITY VENTILATORS

A. Manufacturers:
1. Acme Engineering & Mfg. Corp.
2. American Coolair Corporation: www.coolair.com.
3. Greenheck Fan Corporation: www.greenheck.com.
4. Loren Cook Company: www.lorencook.com.
5. NCA
6. Nailor Industries, United Enertech.
7. Pottorff.
8. Ruskin.

B. Hood Intake and Relief Gravity Ventilator:
1. General:
a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
c. Suitable for non-ducted applications.
d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
2. Hood and Base:
a. Material: Aluminum.
b. Hood Construction: Precision formed, arched panels with interlocking seams.
c. Vertical End Panels: Fully locked into hood end panels.
d. Curb Cap: Pre-punched mounting holes for installation.
3. Birdscreen:
a. Fabricate in accordance with ASTM B221 (ASTM B221M).
b. Construction: 1/2 inch Galvanized mesh.
c. Horizontally mounted across hood intake area.
4. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
5. Options/Accessories:
a. Roof Curbs:
1) Flat Roofs:
(a) Welded, straight side curb with flashing flange and wood nailer.
2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
3) Material: Galvanized.
4) Insulation Thickness: 1 inch.

b. Provide extended base minimum 7 inch extension to base height making overall base 12 inches in height to prevent snow or moisture intake.
c. Curb Seal: Rubber seal between fan and roof curb.
d. Dampers:
    1) Type: Gravity.
    2) Factory designed to prevents outside air from entering back into building when fan is off.
    3) Balanced for minimal resistance to flow.
    4) Galvanized frames with pre-punched mounting holes.
e. Filters:
    1) Mounted in open end racks for easy removal.
    2) Washable 2-inch aluminum mesh designed to remove contaminants from air.
f. Factory Finish: Thermo-setting polyester urethane.
g. Hood Insulation or Coating: Provide 1/2-inch fiberglass insulation lining or anti-condensate coating to prevent condensation and reduce sound levels.
h. Insect Screen:
    1) Fabricate in accordance with ASTM B221 (ASTM B221M).
    2) Construct of fine mesh aluminum.
    3) Fitted to top of throat to prevent entry of insects.
    4) Coating: Thermo-setting polyester urethane.
i. Tie-Down Points: Aluminum brackets located on hood supports to secure fan in heavy wind applications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide volume control (balancing) dampers on duct take-off to all air inlets and outlets, diffusers, grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly. Provide volume dampers in all duct systems

where indicated and required to perform complete system test and balance. Coordinate all volume damper locations with the test and balance contractor.

1. Provide access door or remote damper operator to adjust dampers. Registers and diffusers with dampers shall be used only if devices are installed directly on the trunk duct.

F. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 9123.

G. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

H. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Design Professional for a determination of final location.

I. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

J. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work. Install roof curb level. Install with openings no less than 36 inches above finished roof surface.

K. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.

L. Install louvers in accordance with manufacturer's instructions.

M. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.

N. Install intake and relief ventilators with clearances for service and maintenance.

O. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

P. Label intake and relief ventilators according to requirements specified.

Q. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

R. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, as directed and as required to prevent drafts before starting air balancing.

B. Adjust air patterns per manufactures recommendations based on installed conditions.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 23 5100

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Type B double wall gas vents.

B. Refractory lined metal stacks.

C. Single wall metal stacks.

D. Double wall metal stacks.

E. Special gas venting.

1.2 DEFINITIONS

A. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

B. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

C. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of flues and vents with size, location and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory-built units are used.

D. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

E. Manufacturer's Certificate: Certify that refractory lined metal stacks meet or exceed specified requirements.

F. Designer's qualification statement.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

1.5 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Breechings, Chimneys, and Stacks:
1. DuraVent; DuraStack Pro (DIS2): www.duravent.com/#sle.
2. Metal-Fab, Inc; _____: www.mtlfab.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

A. Regulatory Requirements:
1. Comply with applicable codes for installation of ____ natural gas, propane, and/or fuel oil burning appliances and equipment.
2. Comply with NFPA 31 for installation of oil burning appliances and equipment.
3. Factory-built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and UL listed and labeled.
4. Design refractory lined metal stacks for wind loading of 110 mph and seismic loads for Zone _____.
5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.3 TYPE B DOUBLE WALL GAS VENTS

A. Manufacturers:
1. Amerivent; _____: www.ameri-vent.com/#sle.
2. Hart & Cooley, LLC; _____: www.hartandcooley.com/#sle.

B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

C. Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.66.

2.4 REFRACTORY LINED METAL STACKS

A. Fabricate jacket for size 36 inches and smaller of 24-gauge, 0.0239-inch galvanized steel with grooved seam joint, or 26-gauge, 0.0179-inch aluminized steel with riveted seams. For sizes 39 inches and larger fabricate of 11-gauge, 0.1196-inch galvanized steel with welded seam joint.

B. Weld heavy-gauge stack sections together in factory. Factory-apply heat-resistant paint to each stack section and accessory with primer and finish paint. Touch up or refinish in field.

C. Refractory lining to be a minimum 2 inch thick, proprietary material ASTM C401 Class __ tested to UL 959 and UL listed to withstand 2000 degrees F without fusion, have maximum acid extraction of 0.2 percent, have minimum of 3200 psi cold crush strength, and be positively bonded to steel jacket, jointed with mortar.

2.5 DOUBLE WALL METAL STACKS

A. Manufacturers:
   1. AMPCO; _____: www.ampcostacks.com/#sle.
   2. Selkirk Corporation; _____: www.selkirkcommercial.com/#sle.

B. Provide double-wall metal stacks, tested to UL 103 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 211.

C. Fabricate with 1-inch minimum body soluble fiber insulation between walls, and construct inner liner of 20 gauge, 0.0375-inch 304 stainless steel, and outer jacket of 24 gauge, 0.0239-inch aluminized steel.
   1. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.

D. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
   1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
   2. Design system to compensate for flue-gas-induced thermal expansion.

E. Accessories, UL Labeled:
   1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
   2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.

3. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

2.6 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

A. Double-Wall Special Gas Venting:
1. Manufacturers:
   a. Heatfab Saf-T Vent; Model CI Plus: www.heatfab.com/#sle.
   b. Z-Flex U.S. Inc: www.z-flex.com/#sle.
   c. _____.
   d. Substitutions: See Section 01 6000 - Product Requirements.
2. Provide double-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
3. Fabricate with 1-inch minimum air space between walls and construct inner liner of 28-gauge, 0.015-inch 29-4C stainless steel minimum and outer jacket of 24 gauge, 0.025-inch stainless steel minimum.
   a. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
5. Accessories, UL Labeled:
   a. Exit Cone: Consists of inner cone and outer jacket to increase stack exit velocity 1.5 times.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. For Type B, double-wall gas vents, maintain UL-listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

C. Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

D. Level and plumb chimney and stacks.

E. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

3.2 SCHEDULES

A. Breechings, Chimneys and Stacks.

1. Boiler: Steel breeching, Type B chimney.

END OF SECTION

SECTION 23 5216

CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured units.

B. Boiler construction.

C. Boiler trim.

D. Fuel burning system.

E. Factory installed controls.

1.2 SUBMITTALS

A. Specification Compliance Review.

B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

D. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.

E. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
   1. Indicate compliance with specified performance and efficiency.
   2. Provide results of the following combustion tests:
      a. Boiler firing rate.
      b. Over fire draft.
      c. Gas flow rate.
      d. Heat input.
      e. Burner manifold gas pressure.
      f. Percent carbon monoxide.
      g. Percent oxides of nitrogen.
      h. Percent oxygen.
      i. Percent excess air.
      j. Flue gas temperature at outlet.
      k. Ambient temperature.
      l. Net stack temperature.

m. Percent stack loss.
n. Percent combustion efficiency.
o. Heat output.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

H. Software: Copy of software provided under this section.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.4 REGULATORY REQUIREMENTS

A. Conform to ASME (BPV VIII, 1), ANSI Z21.13, and UL 726 for construction of boilers.

B. Units: AGA certified.

C. Conform to NFPA 70 code for internal wiring of factory wired equipment.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 WARRANTY

A. See the Closeout Submittal Section for additional warranty requirements.

B. Warranty Period for Pulse-Combustion Boilers:
1. Heat Exchanger Damaged by Thermal Shock: 10 years from date of Substantial Completion.
2. Heat-Exchanger Corrosion: Prorated for five years from date of Substantial Completion.

C. Warranty Period for Fire-Tube Condensing Boilers:
1. Leakage and Materials: 10 years from date of Substantial Completion.
2. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated for five years from date of Substantial Completion.

D. Warranty Period for Water-Tube Condensing Boilers: 10 years from date of Substantial Completion.

E. Warranty Period for Water-Jacketed Condensing Boilers:
1. Leakage and Materials: Eight years from date of Substantial Completion.

2. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated for five years from date of Substantial Completion.

F. See the Common Requirements for HVAC specification Section for requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Natural Gas, Propane, or Combination Natural Gas/Propane for Indoor Applications:
1. AERCO International, Inc.
2. Lochinvar LLC: www.lochinvar.com.
3. Fulton Companies: www.fulton.com.
4. Riello Boilers: www.rielloboilers.com

B. No.2 Fuel Oil, Combination Natural Gas/No. 2 Fuel Oil, or Combination Propane/No. 2 Fuel Oil for Indoor or Outdoor Applications:
1. AERCO International, Inc.
2. The Fulton Companies: www.fulton.com.
3. Hurst Boiler & Welding Co., Inc. or Cleaver-Brooks, Inc..
4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MANUFACTURED UNITS

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

C. Annual Fuel Utilization Efficiency (AFUE): 0.82 in accordance with ASHRAE Std 103.

D. Thermal Efficiency as defined by AHRI 1500 (I-P): ____.

2.3 BOILER CONSTRUCTION

A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.

C. Required Directory Listings:
1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI).

D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.

E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.

G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.4 FIRE-TUBE CONDENSING BOILERS

A. Description: Factory-fabricated, assembled, and tested fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air in-take connections; water supply, return, and condensate drain connections; and controls. Water heating service only. Duplex Stainless Steel Option Required.

B. Boiler Characteristics and Capacities: See Drawings for Equipment Schedule.

C. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision, ASME CSD-1.
   1. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

D. Casing:
   1. Jacket: Sheet metal, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Finish: Baked-enamel protective finish.
   4. Insulation: Minimum 2-inch thick fiberglass insulation surrounding the heat exchanger.
   5. Combustion-Air Connections: Inlet and vent duct collars.
   6. Mounting base to secure boiler to concrete base.

2.5 BOILER TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. ASME rated pressure relief valve. 30 psig

D. Flow switch.

E. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

F. Temperature and pressure gauge.

G. Pressure Switches:
   1. High gas pressure.
   2. Low gas pressure.
   3. Air pressure.

H. Manual reset high limit.

I. Boiler Pump (where required by boiler design):
   1. Primary Pump: Non-overloading, horizontal, in-line pump with rubber mounted, split-capacitor motor having thermal-overload protection and oil-lubricated bearings; designed to operate at specified boiler pressures and temperatures.
   2. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
   3. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
   4. Pump time delay.

J. Altitude and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is at approximately 50 percent of full range.

K. Boiler Air Vent: Automatic.

L. Drain Valve: Minimum NPS 3/4 hose-end ball valve.

M. Boiler and Flue Condensate Neutralizing Tank:
   1. Polypropylene construction.
   2. 40 gph capacity per 5000 mbh of boiler capacity. Provide multiple tanks, piped in parallel, on boilers greater than 5000 mbh.
   3. Interior baffles to channel flow thoroughly for complete neutralization, integral bypass to prevent condensate backflow into appliance, NPT connections with unions.
   4. Initial fill of neutralizing material.
      a. Calcium Carbonate
      b. Quartz (SiO2)
      c. Magnesium Oxide

2.6 FUEL BURNING SYSTEM

A. Provide forced draft automatic burner, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
   1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
   2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
   3. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.

D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.7 FACTORY INSTALLED CONTROLS

A. Description: To maintain safe operating conditions, burner safety controls limit the operation of burner.
   1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
   2. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
   3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
   4. Alarm Bell: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

B. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor and control hot-water set point and display boiler status and alarms.

C. Option for internal or external (0-10) VDC control.

D. Temperature Controls:
   1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
   2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
   3. Low-fire start time delay relay.

E. Electronic PI setpoint/modulation control system.

F. Microprocessor-based, fuel/air mixing controls.

G. Control Transformer: 115 V.

H. Sequence of Operation: Electric, factory-fabricated, and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 degrees F outside-air temperature, set supply-water temperature at 200 degrees F; at 60 degrees F outside-air temperature, set supply-water temperature at 140 degrees F.
   1. Include automatic, alternating-firing sequence for multiple boilers.

2.8 VENTING KITS

A. Kit: ASTM A 959, Type 29-4C, stainless-steel, vertical vent terminal, roof passage thimble, indoor wall plate, vent adapter, condensate trap, and sealant.

B. Combustion-Air Intake: Stainless-steel, vertical vent terminal with screen, inlet air coupling, and sealant.

C. Chimney and Type B Vent Adapter: Vent adapter and sealant.

2.9 SOURCE QUALITY CONTROL

A. Provide factory tests to check construction, controls, and operation of unit.

B. Manufacturer to conduct boiler inspection prior to shipment; submit copy of inspection report to Architect.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 03 3000.

D. Coordinate factory installed controls with Section 23 0913.

E. Coordinate provisions for water treatment in accordance with Section 23 2500.

F. Pipe relief valves to nearest floor drain.

G. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer tank prior to discharging into nearest floor drain.
1. Provide a separate neutralizing tank per boiler module.

H. Install primary boiler pump in accordance with Section 23 2123.

I. Provide piping connection and accessories in accordance with Section 23 2114.

J. Connect vent combustion generated fumes to breeching, chimney or exhaust stack; see Section 23 5100.

3.2 SYSTEM STARTUP

A. Engage a factory-authorized service representative to test, inspect, and adjust boiler components and equipment installation and to perform startup service.

B. Perform installation and startup checks according to manufacturer's written instructions.

C. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

D. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Adjust initial temperature set points.

G. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

H. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

I. Prepare written report that documents testing procedures and results.

3.3 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

B. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.

END OF SECTION

SECTION 23 8200

CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic or steam baseboard radiation.

B. Hydronic or steam finned tube radiation.

C. Hydronic or steam convectors.

D. Hydronic or steam unit heaters.

E. Hydronic or steam cabinet unit heaters.

F. Fan-coil units.

G. Duct-mounted coils.

H. Thermostatic controls.

1.2 RELATED REQUIREMENTS

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide typical catalog of information including arrangements.

1.4 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide 5 year manufacturer's warranty for _____.

PART 2 PRODUCTS

2.1 HYDRONIC BASEBOARD RADIATION

A. Manufacturers:
1. Haydon Corporation; _____: www.haydoncorp.com/#sle.
2. Slant/Fin Corporation; _____: www.slantfin.com/#sle.
3. Sterling Hydronics, a Mestek Company; _____: www.sterlingheat.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Perform factory run test under normal operating conditions, water, and steam flow rates.

C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum or aluminum/copper fins.

D. Enclosure:
1. Steel material with high back and top, of one piece construction.
2. Removable front panel, end panel, end caps, corners, and joiner pieces.
3. Full length control damper.
4. Provisions for return piping.

E. Finish:
1. Factory applied, baked enamel finish.
2. Color: As selected from color chart.

F. Element Brackets: Galvanized or pre-painted steel supported from panel with non-metal element cradles or shoes, that allow for noise free expansion and contraction.

2.2 HYDRONIC FINNED TUBE RADIATION

A. Manufacturers:
1. Modine Manufacturing Company; _____: www.modineHVAC.com/#sle.
2. Slant/Fin Corporation; _____: www.slantfin.com/#sle.
3. Zehnder Rittling; _____: www.rittling.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Required Directory Listing: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: 18 gauge, 0.0478 inch sheet steel up to 18 inches in height, 16 gauge, 0.0598 inch sheet steel over 18 inches in height or aluminum as detailed, with easily jointed components for wall to wall installation.

E. Finish: Factory applied baked primer coat.

F. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 by 7 inch minimum size, integral with cabinet.

2.3 HYDRONIC CONVECTORS

A. Manufacturers:
1. Modine Manufacturing Company; _____: www.modineHVAC.com/#sle.
2. Sterling Hydronics, a Mestek Company; _____: www.sterlingheat.com/#sle.
3. Vulcan Radiator, a Mestek Company; _____: www.vulcanrad.com/#sle.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Perform factory run test under normal operating conditions, water, and steam flow rates.

C. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and cast iron headers, steel side plates and supports, factory air pressure tested at 100 psi under water, with means of adjusting pitch of element.

D. Cabinet: 16 gauge, 0.0598 inch sheet steel front and top, 18 gauge, 0.0478 inch sheet steel back and ends; exposed corners rounded; easily secured removable front panels, adequately braced and reinforced for stiffness.

E. Finish: Factory applied baked primer coat.

F. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 by 7 inch minimum size, integral with cabinet.

2.4 HYDRONIC UNIT HEATERS

A. Manufacturers:
1. Modine Manufacturing Company; _____: www.modineHVAC.com/#sle.
2. Sterling Hydronics, a Mestek Company; _____: www.sterlingheat.com/#sle.
3. Trane Technologies, PLC; _____: www.trane.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

C. Perform factory run test under normal operating conditions, water, and steam flow rates.

D. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.

E. Finish: Factory applied baked primer coat.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two- or four- way louvers on horizontal projection models.

H. Control: Local solid state disconnect switch with electropneumatic thermostat.

I. Electrical Characteristics:

2.5 HYDRONIC CABINET UNIT HEATERS

A. Manufacturers:
   1. Modine Manufacturing Company; _____: www.modineHVAC.com/#sle.
   2. Sterling Hydronics a Mestek Company; _____: www.sterlingheat.com/#sle.
   3. Trane Technologies, PLC; _____: www.trane.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.

C. Coils:
   1. Evenly spaced aluminum fins mechanically bonded to copper tubes.

D. Cabinet: Minimum 16 gauge, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.

E. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Control: Factory wired, solid state, infinite speed control, located in cabinet.

I. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

J. Electrical Characteristics:

2.6 FAN-COIL UNITS

A. Manufacturers:
   1. Vertical Cabinet:
      a. Carrier Corporation; _____: www.commercial.carrier.com/#sle.
      b. Daikin Applied; _____: www.daikinapplied.com/#sle.
      c. Krueger-HVAC; _____: www.krueger-hvac.com/#sle.
      d. Trane Technologies, PLC; _____: www.trane.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.
   2. Horizontal Cabinet:
      a. Carrier Corporation; _____: www.commercial.carrier.com/#sle.
      b. Daikin Applied; _____: www.daikinapplied.com/#sle.
      c. Krueger-HVAC; _____: www.krueger-hvac.com/#sle.
      d. Trane Technologies, PLC; _____: www.trane.com/#sle.

e. Substitutions: See Section 01 6000 - Product Requirements.

B. Performance Data and Safety Requirements:
1. Unit capacities certified in accordance with AHRI 440.
2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
4. Equipment wiring to comply with requirements of NFPA 70.

C. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

D. Coils:
1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
3. Provide drain pan under cooling coil easily removable for cleaning.

E. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Controls:
1. Provide units with control valves furnished by the fan coil unit manufacturer.

I. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

J. Electrical Characteristics:

2.7 DUCT-MOUNTED COILS

A. Electric Coils:
1. Manufacturers:
a. Brasch Manufacturing Company; _____: www.braschmfg.com/#sle.
b. INDEECO; _____: www.indeeco.com/#sle.
c. Greenheck.
d. Substitutions: See Section 01 6000 - Product Requirements.
2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
3. Heater Controls:
a. Supply duct temperature sensor.

b. Interlocked airflow switch.
c. Interlocked disconnect switch.

4. Electrical Characteristics:
   a. 6.33 to 9.5 kW.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Do not damage equipment or finishes.

C. Baseboard Radiation:
1. Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated.
2. Center elements under window with elements of equal length centered under each window for multiple windows.
3. Install end caps where units butt against walls.

D. Finned Tube Radiation:
1. Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated.
2. Center elements under window with elements of equal length centered under each window for multiple windows.
3. Install wall angles and end caps where units butt against walls.
4. Align cabinet joints with window mullions.
5. Install wall angles where units butt against walls and align cabinet joints with window mullions.

E. Convectors:
1. Install where indicated.
2. Coordinate to ensure correct recess size for recessed convectors.

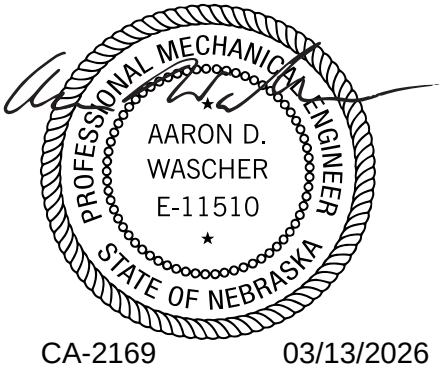
F. Unit Heaters:
1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

G. Cabinet Unit Heaters:
1. Install as indicated.

2. Coordinate to ensure correct recess size for recessed units.

H. Fan-Coil Units:
1. Install as indicated.
2. Coordinate to ensure correct recess size for recessed units.

END OF SECTION



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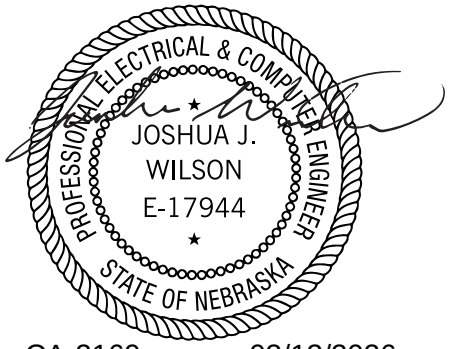
SECTION 23 8216

AIR COILS

PART 2 PRODUCTS

END OF SECTION



SECTION 26 0400

COMMON REQUIREMENTS FOR ELECTRICAL

CA-2169 03/13/2026

PART 1 GENERAL

1.1 SUMMARY

A. This section describes the general requirements of these specifications and shall apply to all phases of the work specified, shown on the drawings, or required to provide for complete installation of all systems for this project.

B. This Section includes basic materials and methods to complement other Division 26 Sections.

1.2 WARRANTIES

A. Warrant materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warranty period.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.3 ALTERNATES

A. Alternates, if required, shall be as described in the “Alternates” section of this Project Manual, as described on the proposal form, or as indicated on the drawings.

1.4 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.5 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.6 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
   1. Architect: Architect or Engineer
   2. Code: Applicable national, state and local codes
   3. Mechanical: Plumbing, HVAC, and Fire Protection work required by the Contract Documents
   4. Electrical: Electrical and Fire Alarm work required by the Contract Documents
   5. Contractor: Any Contractor performing work required by the Contract Documents
   6. Indicated: Noted, scheduled or specified
   7. Selected: Selected by the Architect.
   8. Provide: Furnish, install, connect and tested complete and ready for use
   9. Furnish: Supply and deliver to the site ready for installation
   10. Install: Install complete, per Contract Documents and manufacturer's requirements.
   11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
   12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
   13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
    a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.7 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols on the plans.

1.8 ABBREVIATIONS

A. Refer to abbreviations list on the Drawings.

B. The following abbreviations apply throughout the Contract Documents:
1. ADA: Americans with Disabilities Act
2. ANSI: American National Standards Institute
3. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
4. ASME: American Society of Mechanical Engineers
5. ASTM Specification: Standard specifications of the American Society for Testing Materials
6. FM: Factory Mutual Engineering Corporation
7. IRI: Industrial Risk Insurers
8. NEC: National Electrical Code, latest edition
9. NEMA: National Electrical Manufacturers Association
10. NFPA: National Fire Protection Association
11. UL or Underwriters: Underwriters Laboratories, Inc.

1.9 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. The work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
   1. International Building Code (IBC)
   2. International Fire Code (IFC)
   3. International Energy Conservation Code (IECC)
   4. Safety and Health Regulations for Construction
   5. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards
   6. National Electrical Code (NEC)
   7. National Electrical Safety Code (NESC)
   8. National Fire Protection Association (NFPA)
   9. Life Safety Code (NFPA 101)
   10. Factory Mutual Global Engineering (FMG)
   11. Underwriters' Laboratories, Inc. (UL)
   12. National Electrical Manufacturers Association (NEMA)
   13. Institute of Electrical and Electronics Engineers (IEEE)
   14. Insulated Power Cable Engineers Association (IPCEA)
   15. Telecommunications Industry Association (TIA)
   16. Building Industry Consulting Service International (BICSI)
   17. Applicable national, state and local codes

C. Where there is a conflict between the code and the Contract Documents, the code shall have precedence only when it is more stringent than the Contract Documents.
   1. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.10 PERMITS

A. The Contractors shall familiarize themselves with requirements regarding permits, fees, etc., and shall comply with them.

B. Permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. Utilities shall be installed in accordance with the local rules and regulations.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:

1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufacturers other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
    a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.
    b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
    c. The Contractor providing the substitution shall bear the total cost of changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
5. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.
6. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.

C. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

D. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:
1. Other sections in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.

5. Submittals shall be numbered consecutively.
6. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.
7. Where samples are required, submit one (1) sample of each required item.
8. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
    a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
9. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
10. Samples are physical examples furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate materials, equipment or workmanship and to establish the standards by which the work will be performed.
11. Each submittal shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. Equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
12. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect.
13. When required by other sections of this Project Manual, the Contractor shall submit a Specification Compliance Review consisting of a paragraph-by-paragraph review of the specifications and addenda with the following marked for each paragraph. Markings may be made in the margins of the original specification or addenda. Unless a deviation or exception is specifically noted in the Specification Compliance Review, it is assumed that the equipment, product, or material is in complete compliance with the contract documents. Submit Specification Compliance Review with shop drawings and product data.
    a. “C”: Comply with no exceptions.
    b. “D”: Comply with minor deviations. For each deviation, provide the reasons for the deviation and how the intent of the specification can be satisfied.
    c. “E”: Exception. Equipment, product, or material does not comply. For each exception, provide reasons for the exception, and suggest possible alternatives for the Owner’s consideration.
    d. “N/A”: The paragraph does not apply to the proposed equipment, product, or material.
14. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.

15. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.
16. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.
17. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been reviewed by the Architect. Such portions of the work shall be in accordance with reviewed submittals.
18. The successful Contractor/Supplier may, at their option, obtain DXF or AutoCad DWG electronic drawing files for use in preparation of shop drawings.
    a. This information is available from Alvine upon written request.
    b. A non-refundable handling charge of $10.00 per drawing file requested will be required at the time of receipt of the electronic files.
    c. The use of these drawing files is intended solely for the preparation of drawings as required by these contract documents.
    d. Any other use is strictly prohibited by copyright laws.
    e. The user of these electronic drawing files assumes full responsibility for their accuracy and scale.

B. Operation and Maintenance Manuals:
1. Prepare three (3) operation and maintenance manuals for the equipment furnished. Manuals shall be submitted to the Architect for review and distribution to the Owner not less than 30 days prior to substantial completion of the project. Manuals not meeting the following requirements may be rejected by the Architect.
2. Each manual shall be assembled in a three-ring binder with hard cover and plastic finish. Binders shall not exceed a 3-inch thickness. Where more than one binder is required, the manuals shall be separated into a logical grouping, i.e., “Mechanical”, “Electrical”, “Maintenance”, “Operation”, “Parts”, Shop Drawings”, etc. Each binder shall have the following information clearly printed on its front cover:
    a. Project name and address.
    b. Portion of the work covered by each volume (if more than one volume in the set). Where more than one volume is required, label each volume as “Volume _____ of _____”.
    c. Name, address and telephone number of Contractor and Sub-Contractors including night or emergency number.
3. Manual shall include, but shall not be limited to, the following:
    a. A Complete Index. Contractor may submit the index to the Architect for review prior to submittal of complete manuals if desired.
    b. Names, Addresses and Telephone Numbers. This list shall include the manufacturer and local representative who stocks or furnishes repair parts for all items of equipment and shall be typed on a single page in front of the binder.

c. Startup, Operation and Shutdown Procedures. Provide a written description of procedures for startup, operation and shutdown of each electrical item or system. This description shall include switches to operate, buttons to push, etc., in proper sequence, and the location of switches, starters, and pushbuttons. Description shall include item references or labels used in the contract documents unless otherwise instructed in advance by the Owner.

d. Equipment Accessory Schedule. Upon completion of the work, furnish the Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required and the manufacturer of renewable items.

e. Manufacturer's Operation and Maintenance Manuals and Parts Lists.

f. Emergency Procedures. Provide a written description of emergency operating procedures or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency services to the various parts of the system.

g. One copy of shop drawings and product data, clearly marked for each item furnished using the designation label specified or indicated on Drawings.

h. Manufacturers' warranty information.

i. Normal Maintenance Schedule. Include a listing of work to be performed at various time intervals; i.e., 30, 90, 180 days and yearly.

1.13 OPERATING TRAINING

A. Complete operating instructions for each system and item of equipment shall be provided to the Owner's designated personnel.

B. Operation and Maintenance Manuals must be reviewed and accepted by the Architect and provided to the Owner prior to operating training.

C. Training shall be scheduled at the convenience of the Owner. A minimum of 4 hours of training shall be provided.

D. Training shall include instructions on the following:
1. Startup and shutdown procedures
2. Periodic maintenance
3. Emergency operation
4. Safety

E. In addition to the instructions required above, wherever possible perform the operations being described in order to fully illustrate system operation.

F. At the completion of training, turn over to the Owner required keys and special tools for installed equipment. Each key or tool shall be labeled with its use.

1.14 QUALITY ASSURANCE

A. Conform to the requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.15 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment.
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Coordinate electrical service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

F. Coordinate electrical testing of electrical, mechanical, or architectural items so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

G. Provide offsets and elevation changes in conduit and cable tray as required to complete the Layout and Coordination Process.

1.16 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted electrical system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Architect for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, ductwork, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

PART 2 PRODUCTS

2.1 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Equipment Schedules for Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.2 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. Where the National Electrical Code or applicable codes require equipment to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment. Acceptable methods of complying with this requirement are as follows:
   1. Provide SCCR rating at the equipment that meets or exceeds the available short circuit current at the switchboard or panelboard where the equipment circuit originates.
   2. Provide calculations, based on the available short circuit current at the switchboard or panelboard where the equipment circuit originates, that document the actual short circuit current available at the equipment. The SCCR rating of the equipment shall meet or exceed this calculated value.

2.3 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.4 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.5 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.6 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

PART 3 EXECUTION

3.1 GENERAL

A. Fabrication, erection, and installation of the complete electrical system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. Check areas and surfaces where electrical equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the electrical work.

D. Install equipment and systems in accordance with manufacturer's instructions, requirements, or recommendations.

E. Comply with NECA 1.

F. Unless otherwise noted, measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

G. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

H. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

I. Right of Way: Give to raceways and piping systems installed at a required slope.

J. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.2 DELIVERY AND STORAGE OF MATERIALS

A. Make provisions for the delivery and safe storage of materials. Make the required arrangements with other contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. Adequately protect supplies and equipment during cold weather.

D. Protect items subject to cold weather damage by covering, insulating, or storing in a heated space.

3.3 COOPERATION WITH OTHER CONTRACTORS

A. Perform the electrical work in conformance with the construction called for by other trades and afford other contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the electrical work with the work of other contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the electrical work which might prevent prompt and proper installation of work required from other trades.

3.4 COORDINATION OF WORK

A. Plan work so it proceeds with a minimum of interference with other trades.

B. Inform the General Contractor of all openings required in the building construction for the installation of the electrical work.

C. Cooperate with other contractors in furnishing material and information, in proper sequence, for the correct location of sleeves, inserts, foundations, wiring, etc.

D. Make provisions for special frames, openings, and sleeves as required.

E. The Electrical Contractor shall pay for extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

3.5 LAYING OUT WORK

A. Carefully lay out work in advance of installation using data and measurements from the site, the appropriate civil, architectural, and structural drawings, and shop drawings.

B. Confirm code required clearances.

C. Do not infringe upon space required for operation, maintenance, or clearance for items installed by other contractors.

D. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

E. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and request clarification.

F. Failure to properly coordinate and lay out work will require correction by the Contractor at the Contractor’s expense

3.6 DATA AND MEASUREMENTS

A. Mechanical and Electrical drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and adapt their work to actual conditions.

D. Examine the General Construction, Mechanical, Electrical, and other applicable drawings and the Specifications.

E. Utilize only Architectural drawings, Structural drawings, and site measurements in calculations.

F. Layout and coordinate work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

G. Locate outlets and devices mounted on finished surfaces with regard to paneling, furring, trim, etc.

H. Install outlets and devices with vertical edges of plates plumb.

I. Install boxes or plaster rings such that the front edge extends to the finished surface of the wall, ceiling or floor without projecting beyond the surface.

J. Install receptacles, switches, etc., on wood trim, cases, or other fixtures symmetrically and, where necessary, install with the long dimension of the plate horizontal.

K. Coordinate locations of outlets and devices with other contractors so as not to destroy the aesthetic effect of the surface in which the outlets and devices are mounted. Coordinate the locations of electrical items with work furnished by other trades to avoid interference.

L. Heights of outlets are measured from finished floor to centerline of device.

M. Adjust heights as necessary to clear wall-mounted cabinets, fin tube convectors, unit heaters, etc.

N. Mounting heights shall be in compliance with ADA requirements.

O. Install outlets at the heights indicated below unless otherwise noted.
1. Wall switches: 46 inches.
2. Receptacle outlets (general): 18 inches.
3. Receptacle outlets (kitchen, utility room, workbenches, etc.): 46 inches.
4. Communications outlets: 18 inches.
5. Communications outlets (wall phones): 46 inches.
6. TV outlets: 18 inches.
7. Pushbuttons: 46 inches.
8. Clock outlets: 98 inches when possible Allow space below ceiling to service or replace. Above doors, center between door trim and ceiling.
9. Bells, buzzers, chimes: 8 inches below ceiling (field verify with Architect unless noted otherwise).
10. Fire alarm station: 46 inches.
11. Fire alarm visual signals and audible/visual signals, wall-mounted: 80 inches to the bottom of the lens unless local code or ADA requirement mandates a lower mounting height.
12. Fire alarm audible signals, wall-mounted: Match height of audible/visual signals.
13. Exit lights: 4 inches between top of nearest door frame and bottom of exit sign where possible.

P. The mounting heights of disconnect switches, circuit breakers, motor controllers, pushbutton stations and other similar devices and equipment may vary depending upon location and whether individually or group mounted.

Q. For convenience and safety, mount equipment with the center of operating levers, handles or buttons no more than 72 inches above the finished floor.

R. Locate individual devices or pieces of equipment, unless otherwise specified, so the operating handle, lever or button is located approximately 5 feet above finished floor. Coordinate heights of electrical items with work furnished by other trades to avoid interferences.

S. Improperly located devices or outlets shall be relocated by the Contractor at the Contractor’s expense including necessary patching.

3.7 PROTECTION OF APPARATUS

A. Take necessary precautions to properly protect apparatus, fixtures, appliances, material, equipment, and installations from damage.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.8 SLEEVE INSTALLATION

A. Coordinate sleeve selection and application with selection and application of firestopping.

B. Concrete Slabs and Walls: Install sleeves during erection of slabs and walls. Space sleeves a minimum of three sleeve diameters on center, unless otherwise noted. Sleeves are not required for core-drilled penetrations.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Sleeves through walls: Install flush with both surfaces of wall.

E. Sleeves through floors: Extend 2 inches above finished floor.

F. Sleeves through roofs: Seal with flexible boot-type flashing units applied in coordination with roofing work

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceways or cable unless sleeve seal is to be installed.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Underground, Exterior-Wall Penetrations: Size sleeves to allow for appropriate clear space between raceway and sleeve for sleeve seals.

3.9 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to maintain fire-resistance rating of assembly.

3.10 WORK IN EXISTING BUILDINGS

A. Execute work in the existing building, indicated on the drawings or specified herein, with a minimum amount of interference with the normal activities of the occupants of the building.

B. Schedule work in advance with the Owner and proceed only with the Owner's written approval.

C. Utilities:
   1. Do not interrupt utilities without the Owner's prior written approval regarding the time and duration of such interruptions.
   2. Do not disconnect utilities to existing facilities until new or temporary facilities are installed except for short periods of interruption which are necessary for the performance of the new work and which are approved by the Owner.
   3. Storm water may be temporarily diverted to surface drainage provided such drainage is arranged to prevent flooding of structures, basements and excavations for construction.

D. Fire Alarm System:
   1. As a minimum, maintain the existing degree of protection for all areas throughout construction.
   2. Coordinate required outages with the Owner and the Fire Marshal.
   3. After any additions or modifications to the fire alarm system, a re-acceptance test shall be performed by a licensed party in accordance with NFPA 72.

E. Welding:
   1. Notify the Owner before starting welding or cutting.
   2. Fire extinguishers shall be immediately accessible when welding or cutting with an open flame or arc.
   3. Stop operations involving welding or cutting with an open flame or arc not less than one hour before leaving the premises.

F. Noisy Operations:
   1. Schedule noisy operations, such as those involving use of air hammers, etc., in demolition or cutting of openings, with the Owner.

G. Occupancy:
   1. The Owner will continue to occupy the building and carry on normal activity.
   2. Protect the occupied areas from dust, smoke, etc., by a method reviewed by the Architect.

H. Owner's Right to Direct Work: The Owner shall have the right to direct the places of beginning work, its prosecution, and the manner in which all work under this contract is to be conducted, insofar as may be necessary to secure the safe and proper progress and quality of the work.

I. Existing Conduits or Electrical Equipment:
   1. Remove or relocate, as required, or as directed by the Architect, existing conduit or electrical equipment which would interfere with the proper installation of new work.
   2. Modify existing work in conformance with these specifications.
   3. Use the same materials as for new work unless otherwise specified.

3.11 DEMOLITION AND REMODEL

A. Protect existing electrical equipment and installations indicated to remain.

B. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

C. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

D. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

E. Remove demolished material from Project site.

F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

G. Remove existing lights, receptacles, switches, etc., indicated on plans or which are not indicated but must be removed to accommodate demolition or new remodeling.

H. Where existing walls are indicated to be removed, disconnect power to electrical devices and associated appurtenances relating to the walls.

I. Maintain circuit continuity up and down stream from removed outlets.

J. Extend circuiting to up and downstream devices and reconnect as required.

K. Where existing site lighting fixtures are removed, verify the routing of existing circuits. Maintain circuit continuity between existing fixtures which remain.

L. In areas which are remodeled, replace existing wire with new wire. No existing wire is permitted to remain unless noted.

M. Existing concealed conduit and boxes may be reused.

N. Verify existing conditions in field prior to bid date.

3.12 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations.

B. Perform cutting by skilled mechanics of trades involved.

C. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

D. Install new fireproofing where existing firestopping has been disturbed.

E. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.13 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work. Repair as necessary.

3.14 CLEANING AND PROTECTION

A. Remove burrs, dirt, paint spots, and construction debris from electrical items.

B. Protect electrical items so that finishes are without damage or deterioration at time of Substantial Completion.

C. All cables and wiring shall be protected from paint. This includes but is not limited to power conductors and feeders, lighting control wiring, and fire alarm cabling. Painted cables shall be replaced in their entirety.

3.15 TEMPORARY POWER AND LIGHTING

A. Provide temporary power and lighting throughout the construction period for the use by all trades, Contractors and Sub-Contractors.

B. Temporary facilities shall be installed in compliance with applicable codes and in compliance with OSHA requirements.

C. Cost of temporary power used during construction, including the cost of setting and removing temporary service, shall be paid by the Contractor.

D. Where existing building electrical system is used to provide temporary power and lighting, energy costs shall be paid by the Owner.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Wiring connectors.

C. Electrical tape.

D. Heat shrink tubing.

E. Oxide inhibiting compound.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.3 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
1. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
2. Control Circuits: 14 AWG.

I. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. Equipment Ground, All Systems: Green.
   d. For control circuits, comply with manufacturer's recommended color code.

2.2 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:
   1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2, except as indicated below.
      a. Installed Underground: Type XHHW-2 or THHN/THWN-2.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type THHN/THWN, THHN/THWN-2, or XHHW-2.

2.3 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

C. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.4 ACCESSORIES

A. Electrical Tape:
1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:
1. When circuit destination is indicated without specific routing, determine exact routing required.
2. Install service and feeder conductors unspliced unless otherwise indicated.
3. Arrange branch circuiting to minimize splices.
4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
    a. Provide no more than 6 #12 AWG current-carrying conductors in 1/2 inch conduit; 9 #12 AWG current-carrying conductors in 3/4 inch conduit.
    b. Provide no more than 6 #10 AWG current-carrying conductors in 3/4 inch conduit; 9 #10 AWG current-carrying conductors in 1 inch conduit.
    c. Provide no more than 4 #8 AWG current-carrying conductors in 3/4 inch conduit; 6 #8 AWG current-carrying conductors in 1 inch conduit; 9 #8 AWG current-carrying conductors in 1-1/4 inch conduit.
7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Installation in Raceway:
1. Pull all conductors and cables together into raceway at same time.
2. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
3. Use suitable wire pulling lubricant where necessary, except as below:
    a. Do not use when lubricant is not recommended by the conductor manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Install conductors with a minimum of 6 inches of slack at each outlet.

H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

J. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
2. Damp Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
   a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
3. Wet Locations: Use heat shrink tubing.

L. Insulate ends of spare conductors using vinyl insulating electrical tape.

M. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

N. Identify conductors and cables in accordance with Section 26 0553.

O. Install firestopping to preserve fire resistance rating of partitions and other elements.

P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Verify exact locations of underground metal water service pipe entrances to building.
2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.3 DEFINITIONS

A. ACEG: Alternating Current Equipment Ground

B. BCT: Bonding Conductor for Telecommunications (formerly Telecommunications Bonding Conductor)

C. BBC: Backbone Bonding Conductor (formerly Grounding Equalizer)

D. PBB: Primary Bonding Busbar (formerly Telecommunications Main Grounding Busbar)

E. SBB: Secondary Bonding Busbar (formerly Telecommunications Grounding Busbar)

F. TBB: Telecommunications Bonding Backbone

1.4 SUBMITTALS

A. Product Data: Provide for ground bars.

B. Telecommunications Grounding Test Reports.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Comply with TIA/EIA-607 for telecommunications grounding.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground structure that is connected to the earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of bare copper conductor sized as indicated on drawings

embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Rod Electrode(s):
   a. Provide single electrode unless otherwise indicated or required.
   b. Space electrodes not less than 10 feet from each other and any other ground electrode.
6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

E. Service-Supplied System Grounding:
1. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

F. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for metal building frame.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:

1) Use bare tinned copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections, high-pressure compression conections, or high-pressure compression conections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use compression connectors for accessible connections. For #6 AWG and smaller, use one-hole lugs. For #4 AWG and larger, use two-hole lugs.
a. Exceptions:
1) Use exothermic welded connections or high-pressure compression connections for connections to metal building frame.
4. Manufacturers - High-Pressure Compression Connectors:
a. Burndy: www.burndy.com; Hyground System
b. Thomas & Betts: www.tnb.com.

D. Ground Bars:
1. Description: Tinned copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Mount ground bars in horizontal orientation.

E. Install each bonding conductor in a direct route, and parallel or perpendicular to building structure or surfaces, without interfering with other systems or equipment.

F. Install exterior grounding electrode conductors with a minimum bending radius of 12 inches.

G. Install interior grounding conductors with a minimum bending radius of 8 inches.

H. Install grounding conductors in EMT conduit unless otherwise indicated. Bond each end of the conduit to the grounding conductor using an appropriate grounding bushing.

I. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

J. Identify grounding and bonding system components in accordance with Section 26 0553.
   1. Clean each surface prior to attachment of label.
   2. Follow manufacturer's recommendations for affixing labels.
   3. Ground Bars: Provide engraved laminate with 1-inch high letters. Locate at the upper left-hand side of bar. Engrave with bar designation followed by unique identifier as indicated on drawings.
      a. MGB-
      b. PBB-
      c. SBB-

3.3 TELECOMMUNICATIONS GROUNDING

A. When present, bond the following to the PBB:
   1. Building steel.
   2. Panelboards located in the same room as the PBB. Use ACEG connected to panelboard ground bus.

B. When present, bond the following to the nearest SBB:
   1. Panelboards located in the same room as the SBB. Use ACEG connected to panelboard ground bus.
   2. Building steel.

C. Conductor Labeling: Provide machine-printed, self-adhesive label equivalent to Brady label or Brother P-Touch label. Attach to each accessible end and at each break in the insulation for the cables indicated below. Indicate cable designation followed by unique numeric identifier.
   1. TBC
   2. TBB
   3. BBC
   4. ACEG

3.4 FIELD QUALITY CONTROL

A. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

B. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

C. Telecommunications Grounding system Testing and Documentation.
   1. Perform tests based on TIA/EIA-607, "Commercial Building Grounding and Bonding Requirements for Telecommunications" and document results to insure proper grounding of the telecommunications system.
   2. Tests require the following:
      a. Equipment set-up and reference test.
      b. Ground electrode resistance testing.
      c. Grounding system continuity test.
      d. Test result documentation.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
a. NFPA 70.
b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load

to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
    a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts, expansion anchors, or expansion anchors.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.

G. Cable Supports for Vertical Conduit: Factory-fabricated body with insulated wedging plug, appropriately sized for conductors being supported.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3-1/2 inch high concrete pad.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
   6. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. Secure fasteners in accordance with manufacturer's recommended torque settings.

I. Remove temporary supports.

J. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

SECTION 26 0533.13

CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible metal conduit (FMC).

B. Liquidtight flexible metal conduit (LFMC).

C. Galvanized steel electrical metallic tubing (EMT).

D. Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.3 QUALITY ASSURANCE

1.4 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Dry Locations:
   1. Concealed: Use electrical metallic tubing.
   2. Exposed: Use electrical metallic tubing.

C. Connection to Motors: Use liquid-tight flexible metal conduit, except use flexible metal conduit in air plenums.

D. Connection to Vibrating Equipment (including transformers):
   1. Indoors: Use flexible metal conduit.
   2. Outdoors: Use liquid-tight flexible metal conduit.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Provide conduit, fittings, supports, and accessories required for complete raceway system.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2-inch trade size.
   2. Telecommunications Pathways: 1 inch trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel, malleable iron, or die cast zinc.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360; rated for use with conductors rated 75 degrees C.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel, malleable iron, or die cast zinc.

2.5 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Colored EMT:
   1. Manufacturer: Allied Tube and Conduit.
   2. Color Code:
      a. Fire Alarm: Red
      b. HVAC Controls: Blue

C. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel, malleable iron, or die cast zinc.
   3. Connectors and Couplings: Use compression/gland or set-screw type.
      a. Do not use indenter type connectors and couplings.
   4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.6 ACCESSORIES

A. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 200 lbf.

B. Foam Conduit Sealant:
   1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
   2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   3. Rated to hold minimum of 10 ft water head pressure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
    a. Electrical rooms.
    b. Mechanical equipment rooms.
5. Unless otherwise approved, do not route exposed conduits:
    a. Across floors.
    b. Across roofs.
    c. Across top of parapet walls.
    d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Exterior Branch Circuits: Route conduits adjacent to curbs. Push or directional bore conduits beneath paved areas; otherwise, sawcut and remove pavement. Replace removed pavement to match existing.
10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
11. Maintain minimum clearance of 12 inches between conduits and hot surfaces.
12. Group parallel conduits in same area on common rack.

D. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
    a. Support PVC conduit within 3 feet of termination points and at intervals not exceeding those listed below in accordance with NFPA 70 Table 352.30.
        1) 1/2" to 1" trade size = 3 feet spacing between supports.
        2) 1-1/4" to 2" trade size = 5 feet spacing between supports.
        3) 2-1/2" to 3" trade size = 6 feet spacing between supports.
        4) 3-1/2" to 5" trade size = 7 feet spacing between supports.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use of spring steel conduit clips for support of conduits is permitted only as follows:
    a. Support of electrical metallic tubing (EMT)1-1/2 inch trade size concealed above accessible ceilings and within hollow stud walls.
5. Use of wire for support of conduits is permitted only as follows:

a. For suspending conduits supported by spring steel conduit clips, where specifically indicated or permitted.

E. Connections and Terminations:
1. Use suitable adapters where required to transition from one type of conduit to another.
2. Provide insulated bushings on box connectors 1-inch and larger, on conduits stubbed above an accessible ceiling, and on conduits used for telecommunications pathways.
3. Secure joints and connections to provide mechanical strength and electrical continuity.

F. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
4. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
5. Install firestopping to preserve fire resistance rating of partitions and other elements.

G. Conduits Beneath Slab on Grade:
1. Transition to rigid steel conduit, intermediate metal conduit, or electrical metallic tubing where conduit exits slab, except where concealed in walls rigid nonmetallic conduit may be stubbed a maximum of 14 inches above floor level.

H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

I. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
a. Where conduits enter building from outside.
b. Where service conduits enter building from underground distribution system.
c. Where conduits enter building from underground.
d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant, junction box, or type C condulet at accessible point near penetration to prevent condensation. This includes, but is not limited to:

a. Where conduits pass from outdoors into conditioned interior spaces.
b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

J. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

K. Provide grounding and bonding; see Section 26 0526.

L. Identify conduits; see Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable caps to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.16

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.2 REFERENCE STANDARDS

A. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

C. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

D. NFPA 70 - National Electrical Code.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

G. UL 508A - Industrial Control Panels.

H. UL 514A - Metallic Outlet Boxes.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for floor boxes and poke thru devices.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Do not use "through-wall" boxes designed for access from both sides of wall.
7. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
8. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
9. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

10. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
11. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Communications Systems Outlets: 4 inch square by 2-1/8 inch deep trade size.
    c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
12. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Include cable supports if any dimension of the box is greater than 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes prior to rough-in.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:
1. Locate boxes to be accessible. Provide access panels as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in unfinished areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

H. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

R. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

S. Orient each box located above an accessible ceiling so the box opening faces down or to one side.

T. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

U. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

V. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Identification for conductors.

D. Underground warning tape.

E. Warning signs and labels.

1.2 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. NFPA 70E - Standard for Electrical Safety in the Workplace.

1.3 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify electrical equipment.
      a. Enclosed switches, circuit breakers, and motor controllers:
         1) Identify power source and circuit number. Include location.
         2) Identify load(s) served.
   2. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
   3. Available Fault Current Documentation: Use identification nameplate to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial

control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.

a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Raceways:

1. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use color-coded box covers to identify specified systems.
   a. Color-Coded Box Covers: Field-painted with two coats of enamel paint per the color code below:
      1) Fire Alarm System: Red.
   b. For exposed boxes in public areas, do not color code.
2. Use handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, provide identification on inside face of cover.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   a. Color: White text on black background.

B. Identification Labels:

1. Manufacturers:
   a. Brady Corporation: www.bradyid.com/#sle.
   b. Brother International Corporation: www.brother-usa.com/#sle.
   c. Panduit Corp: www.panduit.com/#sle.

2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
4. Color: Black text on clear background. Provide black text on white background when applying to a dark surface.

C. Format for Equipment Identification:
1. Minimum Size:
   a. Plastic Nameplates: 1 inch by 2.5 inches.
   b. Identification Labels: 0.5 inch by 2.5 inches.
2. Minimum Size: 1 inch by 2.5 inches.
3. Legend:
   a. Equipment designation or other approved description.
4. Text: All capitalized unless otherwise indicated.
5. Minimum Text Height:
   a. Equipment Designation: 3/8 inch.

2.3 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.4 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: inside of equipment door when installed in a finished location.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Boxes: Outside face of cover.
6. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws or self-adhesive backing and to interior surfaces using self-adhesive backing.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 6 inches below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 0583

WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 REFERENCE STANDARDS

A. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

B. NFPA 70 - National Electrical Code.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
2. Determine connection locations and requirements.

B. Sequencing:
1. Install rough-in of electrical connections before installation of equipment is required.
2. Make electrical connections before required start-up of equipment.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MATERIALS
1. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
2. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

C. Provide receptacle outlet to accommodate connection with attachment plug.

D. Provide cord and cap where field-supplied attachment plug is required.

E. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

F. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

G. Provide final power and control connections for equipment furnished under other Divisions of this specification and for Owner-furnished equipment. Where not specified in mechanical sections of this specification, connect motor controls and associated mechanical equipment as required for a complete and functional control system.

H. Provide interlocks and wiring to and between controls for Owner-furnished equipment, boilers, pumps, fans, water treatment systems, and chemical feed systems.

I. Verify control wiring requirements with manufacturer certified shop drawings for each piece of equipment or control system and install accordingly. Install control wiring in conduit.

3.3 EQUIPMENT REQUIREMENTS

A. Electric Duct Heaters:

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Device plates and box covers.

1.2 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

C. NFPA 70 - National Electrical Code.

D. UL 20 - General-Use Snap Switches.

E. UL 498 - Attachment Plugs and Receptacles.

F. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

2.2 MANUFACTURERS

A. Cooper Wiring Devices: www.cooperwiringdevices.com.

B. Hubbell Incorporated: www.hubbell-wiring.com.

C. Leviton Manufacturing Company, Inc: www.leviton.com.

D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

E. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.3 WIRING DEVICE FINISHES

A. Device Color: Gray unless otherwise indicated or required by code; brown in dark brick, wood paneled or dark-finished walls.

2.4 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Acceptable products are listed below for specific device types.

C. Standard Switches: 20A, 120/277 V AC

Description	Cooper	Hubbell	Leviton	P & S
Single pole	CSB120	CSB120	CS120-2	CSB20AC1
Double pole	CSB220	CSB220	CS220-2	CSB20AC2
Three-way	CSB320	CSB320	CS320-2	CSB20AC3

Four-way	CSB420	CSB420	CS420-2	CSB20AC4
Description	Cooper	Hubbell	Leviton	P & S
Single Pole	AH1221L	HBL1221L	1221-2L	PS20AC1L
Double Pole	AH1222L	HBL1222L	1222-2L	PS20AC2L
Three-way	AH1223L	HBL1223L	1223-2L	PS20AC3L
Four-way	AH1224L	HBL1224L	1224-2L	PS20AC4L

D. Special Switches

Description	Cooper	Hubbell	Leviton	P & S
Single pole with pilot light	AH1201PL	HBL1221PL	1221-PLR	PS20AC1RPL
Single pole momentary contact	1995	HBL1557	1257	1251
Single pole lighted toggle	AH1221LT	HB1221IL	1221-LH	PS20AC1ISL
Combination switch/receptacle	TR291	RR108	5335	671
Door switch	-	RDS50	1865	-

2.5 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. Acceptable products are listed below for specific device types.

C. Straight Blade Receptacles: 20A, 125V.

Description	Cooper	Hubbell	Leviton	P & S
Simplex	1877	HBL5361	5891	5361
Duplex	BR20	BR20	5362	CRB5362
Duplex tamper resistant	TRBR20	BR20TR	T5362	TR5362
Duplex GFCI	SGF20	GFRST20	GFNT2	2097
Duplex GFCI tamper resistant	TRSGF20	GFTRST20	GFTR2	2097TR
Duplex GFCI weather resistant	WRSGF20	GFRWR20	GFWT2	2097TRWR
Duplex GFCI weather resistant, tamper resistant	WRSGF20	GFRTW20	GFWR2	2097TRWR

Duplex isolated ground	IG5362	IG20CR	5362-IG	IG5362
Duplex tamper resistant with USB-A and USB-C charging ports	TRUSBAC20	USB20AC5	T5833	TR20USBAC6
Duplex TVSS	5362S	HBL5362SA	7380	5362SP
Clock hanger	775V	RR151CHI	688	S3713

2.6 WALL PLATES AND COVERS

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Screws: Metal with slotted heads finished to match wall plate finish.

B. Wall Plates for Flush Devices: Type 302 or 304, satin finished stainless steel, minimum thickness 0.03 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.

B. Install wiring devices in accordance with manufacturer's instructions.

C. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

D. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

E. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices unless otherwise indicated.

G. Install wiring devices plumb and level with mounting yoke held rigidly in place.

H. Install wall switches with OFF position down.

I. Install vertically mounted receptacles with grounding pole on bottom.

J. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

K. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas and above accessible ceilings.

3.4 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Fuses: Three of each type and size, unless a greater quantity is indicated on drawings.
2. Fuse Pullers: One set(s) compatible with each type and size installed.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.2 APPLICATIONS

A. Fuses Larger Than 600 Amps: Class L, time delay, equivalent to Bussmann Low Peak.

B. Fuses 600 Amps or Smaller: Class RK1, time delay, equivalent to Bussmann Low Peak. Provide with open fuse indication where avialable.

C. Fuses for Use in Coordination Panel: Main Switch, Class J, time delay, equivalent to Bussmann Low Peak; branch switches, Class J, time delay, equivalent to Bussmann Low Peak CUBEFuse. Provide with open fuse indication.

D. Plug Fuses: Class S, time delay, equivalent to Bussmann Fustat. Provide with a Bussmann catalog number SSY device cover incorporating a switch and fuse holder. Where a lockable switch is required, provide a Bussmann catalog number SOY box cover with fuse holder mounted adjacent to a locking toggle switch.

E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Provide the following accessories where indicated or where required to complete installation:
   1. Fuseholders: Compatible with indicated fuses.
   2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. For motor circuits, provide fuses rated at 125 percent of motor nameplate full load current.

C. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2816.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Project Record Documents: Record actual locations of enclosed switches.

C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier, where possible.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Provide with switch blade contact position that is visible when the cover is open.

G. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Switches Larger than 600 Amps: Class L
   2. Switches 600 Amps or smaller: Class R.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

K. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
    a. Indoor Clean, Dry Locations: Type 1.
    b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

M. Heavy Duty Switches:
1. Comply with NEMA BS 31047.
2. Conductor Terminations:
    a. Provide mechanical lugs unless otherwise indicated.
    b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

N. Provide the following features and accessories where indicated or where required to complete installation:
1. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 60 inches above the floor or working platform.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

J. Identify enclosed switches in accordance with Section 26 0553.

K. Install fuses in fusible disconnect switches.

L. Bolt closed exterior grade level enclosures.

3.3 FIELD QUALITY CONTROL

A. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913

ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
   1. Magnetic motor starters.
   2. Manual motor starters.

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Control accessories:
   1. Auxiliary contacts.
   2. Pilot devices.
   3. Control and timing relays.
   4. Control power transformers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
   3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

C. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

D. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Indicating Lights: Two of each different type.

1.4 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.6 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

2.2 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
      a. Altitude:
         1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
         2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:
   1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:
   1. Comply with NEMA IA 10030.
   2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
   3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

I. Magnetic Motor Starters: Combination type unless otherwise indicated.
   1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
   2. Configuration: Full-voltage non-reversing unless otherwise indicated.
   3. Disconnects: Circuit breaker type.
      a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
      b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
      c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   4. Overload Relays: Solid-state type unless otherwise indicated.
   5. Pilot Devices Required:

a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
b. Single-Speed, Non-Reversing Starters:
1) Pushbuttons: RESET.
2) Selector Switches: HAND/OFF/AUTO.
3) Indicating Lights: Red ON.

J. Manual Motor Starters:
1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
2. Configuration: Non-reversing unless otherwise indicated.
3. Fractional-Horsepower Manual Motor Starters:
a. Furnish with toggle operator.
b. Overload Relays: Bimetallic or melting alloy thermal type.
c. Provide means for locking operator in the OFF position.
d. Furnish Red ON indicating light.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
a. Employ manual reset unless otherwise indicated.
b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
a. Interchangeable current elements/heaters.
7. Melting Alloy Thermal Overload Relays:
a. Interchangeable current elements/heaters.
b. Selectable inverse-time trip class rating; available ratings of Class 10, 20, and 30, minimum.

B. Circuit Breakers:
1. Interrupting Capacity (not applicable to motor circuit protectors):
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Motor Circuit Protectors:
a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489

recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.

b. Provide field-adjustable magnetic instantaneous trip setting.

2.4 CONTROL ACCESSORIES

A. Auxiliary Contacts:
1. Comply with NEMA IA 10039.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:
1. Comply with NEMA IA 10039; heavy-duty type.
2. Nominal Size: 30 mm.
3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
5. Indicating Lights: Standard (non-push-to-test) type unless otherwise indicated.
6. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
1. Comply with NEMA IA 10039.
2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:
1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices; 120 volt secondary.
2. Include primary and secondary fuses.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Select controller to match characteristics of supply circuit and installed motor.

B. Install products in accordance with manufacturer's instructions.

C. Install controllers in accordance with NECA 1 (general workmanship).

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install enclosed controllers plumb and level.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Install all field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

K. Identify enclosed controllers in accordance with Section 26 0553.

3.3 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.5 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION